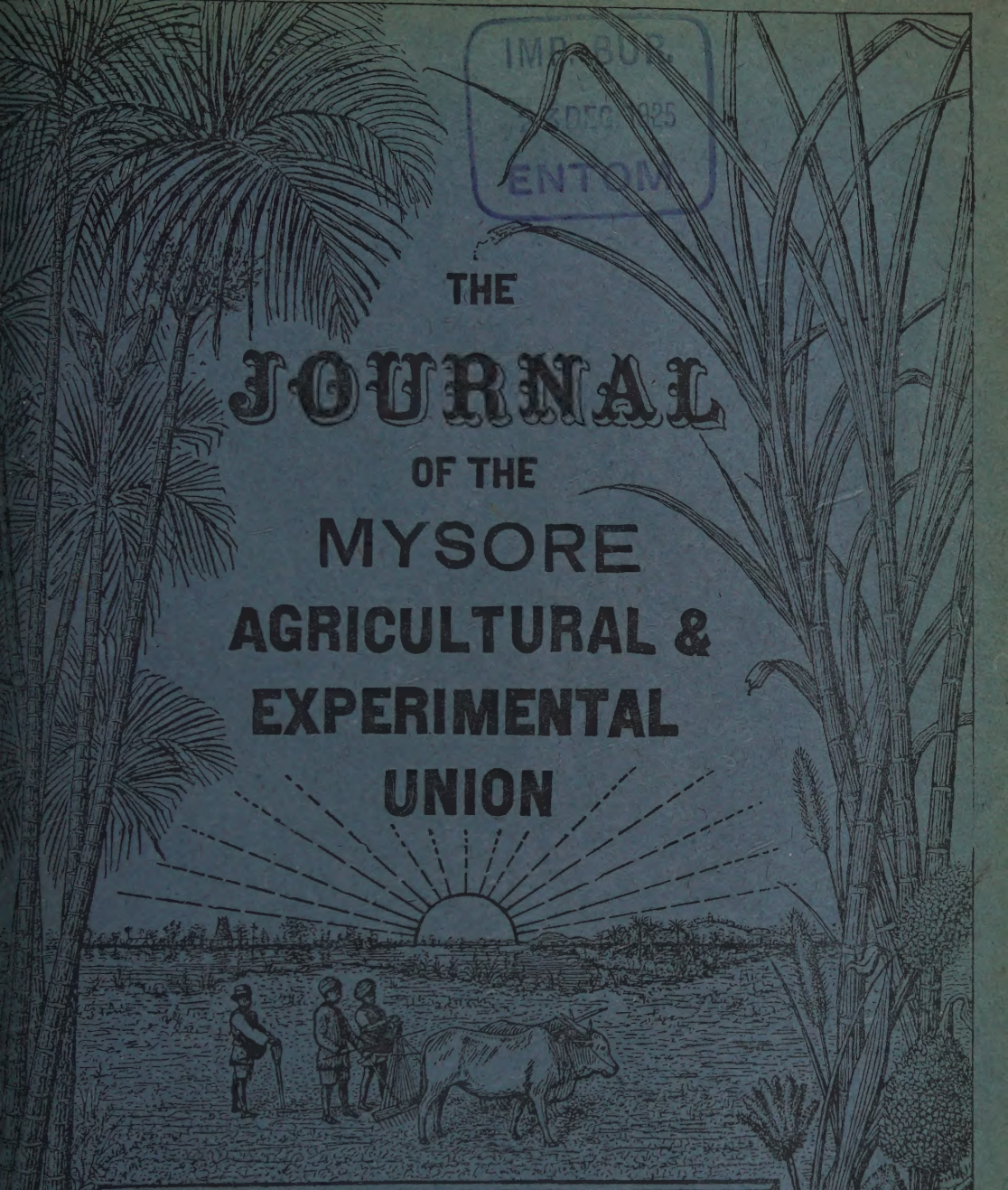
IMP. BUR.
DEC 1925
ENTOM

THE JOURNAL OF THE MYSORE AGRICULTURAL & EXPERIMENTAL UNION



Vol. VII.] 1925 [No. 2

PRINCIPAL CONTENTS.

Presentation of an Address to our President.

Agricultural Co-operation with Special Reference to the Bangalore District—By A. K. Yegnanarayana Iyer, M.A., Dip. in Agri. (Cantab.), N.D.D., etc.

Agricultural Research in Relation to the Community—By Sir Daniel Hall, K.C.B., LL.D.,

THE JOURNAL OF THE MYSORE AGRICULTURAL AND EXPERIMENTAL UNION.

A quarterly magazine devoted to the advancement of Agriculture and published by the Mysore Agricultural and Experimental Union.

Chief Editor

B. Narasimha Iyengar, B.A., Ph.D., Agricultural Chemist.

Associate Editors

K. Kunhi Kannan, M.A., Ph.D., Entomologist.
M. J. Narasimhan, B.A., Senior Assistant Mycologist.
Leslie C. Coleman, M.A., Ph.D., Director of Agriculture in Mysore.
M. G. Singarachar, B.A., A.C.E., Agricultural Engineer.
W. Davison, B.S.A., Live-Stock Expert.
N. Krishna Iyengar, B.A., Inamdar, Uragahally Estate.
Major R. W. Simpson, M.C., G.B.V.C., Superintendent, Civil Veterinary Dept.
D. G. Ramachandra Rao, Assistant Director of Agriculture.
H. Srinivasa Rao, Retired Deputy Conservator of Forests.
T. Narasinga Rao, Coffee Planter.
B. Venkatanarnappa, M.A., Professor, Central College.
K. Bhima Rao, B.A., F.C.S., Senior Assistant Chemist.
N. Rama Rao, B.A., B.L., Superintendent, Sericultural Department.

Secretary

N. Venkatsubbaya, Rural Science Supervisor.

Rates of Subscription :—

Free to members of the Union.
Rupees 3 per volume to non-members.
Foreign subscription 4 shillings.
Subscription can begin from any number desired.
Individual copies, annas 12. Foreign, 1 shilling.
Postage Extra.

Rates of Advertisement:—

	Single Insertion.	Annual. (4 consecutive numbers.)	
Full page ... Royal Octavo	Rs. 10	Rs. 32	Payable in advance.
Half page ...	Rs. 5	Rs. 16	

All communications should be addressed to the Editor, the Journal of the Mysore Agricultural and Experimental Union, Sheshadri Road, Bangalore.

Taken on the occasion of

the Presentation of an Address to Our President, **Dr. Leslie C. Coleman**, M.A., Ph.D., Director of Agriculture in Mysore.

CONTENTS.

	Pages.
Presentation of an Address to our President	55—70
Agricultural Co-operation with Special Reference to the Bangalore District—By A. K. Yegnanarayana Iyer, M.A., Dip. in Agri. (Cantab.), N.D.D., etc., Deputy Director of Agriculture in Mysore	70—81
Results of Experiments regarding the Comparative Merits of Propagating Pepper by means of Cuttings got from Top *versus* from Bottom of the Mother Vines	81
NOTES AND COMMENTS.—	
Our President—Live-Stock Work in Mysore—Agricultural Costings in Switzerland and Denmark—The Jola Ear-Head Fly	82—85
SELECTIONS.—	
The Dietetics of Coffee—Pedigreed Cattle—Studies on Rice Cultivation—Intensive Nitrifying Bed as a Means of Preventing Nitrogen Losses from Cattle Manure—European Planters Entertain Dr. Coleman—The Utilization of Seedlings in the Estimation of Soil Nutrients—Agricultural Research in Relation to the Community	86—108

The Mysore Agricultural and Experimental Union

MANAGING COMMITTEE FOR 1925

President.—Dr. Leslie C. Coleman, M.A., Ph.D.

Vice-President.—Mr. H. Srinivasa Rao, Hongenahally, Malur.

MEMBERS.

1. Mr. A. K. Yegnanarayana Iyer, M.A., N.D.D., etc.
2. Prof. B. Venkatanarnappa, M.A.
3. Mr. N. Krishna Iyengar, B.A.
4. Dr. B. Narasimha Iyengar, B.A., Ph.D.
5. Mr. R. Gopalaswamy Iyer.
6. ,, N. Rama Rao, B.A., B.L.
7. ,, M. S. Lingegowda.
8. Srimati D. Sakamma.
9. Dr. K. Kunhi Kannan, M.A., Ph.D
10. Mr. B. Srinivasa Iyengar.
11. ,, K. Bhima Rao, B.A., F.C.S.
12. ,, D. G. Ramachandra Rao.

The Journal
of the
Mysore Agricultural
and
Experimental Union.

Vol. VII. 1925. No. 2

Presentation of an Address to our President.

The non-official members of the Mysore Agricultural and Experimental Union presented an address to Dr. Leslie C. Coleman, M.A., Ph.D., President of the Union and Director of Agriculture in Mysore, on the 3rd July, 1925, at the Daly Memorial Hall. Representative agriculturists attended from all parts of the State. The Daly Hall was crowded to the fullest extent. The following among other distinguished visitors were present :—Mushir-ul-Mulk Mr. Mir Humza Hussein, B.A., B.L., Retired Offg. Dewan of Mysore; Rajasabhabhushana Rev. Father A. M. Tabard, M.A., M.B.E., M.R.A.S.; Mr. K. R. Srinivasiengar, M.A., Member of Council; Mr. K. Chandy, B.A., Member of Council; Mr. B. Ramaswamaiya, B.A., B.L., Chief Secretary to Government; Mr. C. S. Balasundaram Iyer, B.A., Revenue Commissioner; Mr. K. Matthan, B.A., Inspector-General of Education; Mr. P. G. D'Souza, B.A., B.L., Director of Industries and Commerce; Mr. K. H. Ramayya, B.A., Bar-at-Law, Registrar of Co-operative Societies; Mr. B. V. Ramaiengar, B.A., Conservator of Forests; Mr. and Mrs. O'Brien of the Bank of Mysore; Srimati D. Sakamma and others.

The proceedings commenced at 5-30 P.M. with an invocation. Prof. B. Venkatanaranappa, then proposing Mushir-ul-Mulk Mr. Mir Humza Hussein to the Chair, spoke as follows :—

Ladies and Gentlemen,

The first business on the agenda to-day is the formal election of the Chairman to preside on this very important occasion. We, the members of the Mysore Agricultural and Experimental Union, are highly thankful to Mushir-ul-Mulk Mr. Mir Humza Hussein for having readily consented to take the Chair this evening. He has all along been a friend of our **Union** and, though not a practical agriculturist himself, has the quality, unfortunately rare in Mysore, of being in full sympathy with the aims and aspirations of the Mysore agriculturist. It is peculiarly unfortunate for Mysore that Dr. Coleman, the idol of the Mysore agriculturist, should be leaving us just at this juncture. When the wolf of unemployment is knocking at our very doors, we do not seem to have a sufficient number of far-sighted statesmen in our country to tackle this very serious problem of unemployment with earnestness. Our benign Government has been doing much in this direction, but I am afraid it is not enough. We, the members of this **Union,** representing as we do the agriculturists of Mysore, want a leader very badly. Such a leader should be able to command not only the respect of the people but also of the Government. He should have wide experience of agricultural conditions in Mysore, should be in full sympathy with the aims and aspirations of the people and above all, should be a true son of Mysore, far-sighted and ever anxious and capable to lead the country out of difficult situations. Such a person, we believe, we have in Mr. Humza Hussein. He is a true Mysorean, has served the State loyally in a number of responsible positions for nearly 35 years and has full experience of the conditions of the country. He was, as Member of Council, always anxious to have the agricultural portfolio in his hands and has been instrumental in obtaining recognition for our Union from the Government. He gave us some valuable advice on the last occasion on which he presided at our Annual Meeting. We believe that even now he is trying to solve some knotty problems in agriculture. We fully believe that the hungry wolf at our doors can be turned out by agriculture and agriculture alone ; and we have no doubt that Mr. Humza Hussein, who is now enjoying a well-earned

rest, will champion our cause and lead the country on to fruitful fields of contentment.

Gentlemen, with these few remarks I have great pleasure in proposing Mr. Mir Humza Hussein to the Chair.

Mr. M. G. Shama Rao of Bowringpet formally seconded the resolution.

Mushir-ul-Mulk Mr. Mir Humza Hussein then took the Chair and spoke as follows :—

Ladies and Gentlemen,

We are assembled here to express our gratitude and admiration for the splendid work done by Dr. Coleman during his tenure of office as Director of Agriculture and to say good-bye on the eve of his departure from our midst. Parting with such a good friend of the State and its people fills one's mind with anguish and I would not have consented to preside on this melancholy occasion but for the fact that I want to pay my quota of tribute to him who has toiled so hard in the service of the State for the benefit of its teeming millions and with such conspicuous success.

After a brilliant career in the Universities of Toronto and Gottingen, Dr. Coleman joined the Mysore Service in 1908 as Entomologist and Mycologist to the Government of Mysore. No sooner did he enter upon his duties than he commenced a campaign against the pests that attack the jola crop and the methods devised by him are successfully pursued to this day by the ryots with immense relief to the valuable crops. He was sent on deputation to Europe in 1912 and on his return he was appointed Director of Agriculture. The present Agricultural Department with its manifold branches was organized by him and he nursed and fostered it with great care. Its efficiency is so great that it has already attained an international reputation which has greatly enhanced the prestige of the State.

Agriculture in Mysore, when Dr. Coleman took charge of the Department, was in a very primitive condition and was untouched by the influence of Western Sciences. The agriculturists were quite ignorant of the use of improved machinary and appliances and were carrying on agricultural operations after the fashion of their forefathers in a crude and unscientific manner. Dr. Coleman introduced the modern plough and popularized it with the people. Not

content with this, he has invented a new plough whose usefulness has been established beyond a shadow of doubt. The plough has not only become popular with the people of Mysore, but its reputation has travelled far and it is largely requisitioned by the Agricultural Departments of British India.

Under his guidance the strains of several staple crops have been improved. The variety of ragi known as H. 22 evolved by him is yielding an abundant crop. He has done a great deal for the improvement of sugarcane cultivation. The several varieties evolved on the Hebbal Farm are very popular with the ryot and are bringing in a good return. The new variety of cotton evolved recently promises to become a boon to the cotton growers of the State. The improvement of potato and groundnut crops is also due to scientific investigation. In the matter of paddy cultivation he has introduced the system of planting single seedlings which is a great improvement upon the present system. All this means increased wealth and there can be no doubt that under his able and sympathetic guidance the prosperity of the ryot has considerably increased. Of course, he has not been able to banish famine altogether from the land, but there is no denying the fact that as the result of the operations of his Department, the ryot is much better able to stand a season of drought than his forefathers did.

It is due to the initiative and foresight of Dr. Coleman that Agricultural Depots have been established at various centres and manure and agricultural implements are sold to ryots to facilitate their agricultural operations. The Co-operative Department is indebted to him for the helping hand he gave for the spread of agricultural co-operation.

But the name of Dr. Coleman will be long remembered by the people of the Malnad where the Koleroga operations started by him have proved such a splendid success and which have saved the arecanut grower from the serious situation which was awaiting him.

He was instrumental in establishing the Hebbal Farm and the Agricultural School which have been doing yeoman service in popularizing scientific agriculture in the State. Through his enthusiasm, which

has been quite infectious, a class of gentlemen farmers is springing up by which in course of time the problem of unemployment is likely to be solved or at least remunerative occupation afforded to hundreds of our young men who are in search of appointments. The cry of "Back to the Soil" which is now raised as a remedy for unemployment can be effectively worked out only if men of the type of Dr. Coleman are at the head of the Agricultural Department.

The debt which the people of Mysore owe to Dr. Coleman is very great and they cannot discharge it by any conventional words. The agricultural awakening of the people is entirely due to his untiring energy, zeal and devotion to duty. The secret of his success lay in the fact that he freely moved with the people, studied their wants and sympathized with their sufferings. No wonder then that the ryot had unbounded confidence in him and adopted whatever suggestion he made for the improvement of his condition.

The Agricultural Union, under the auspices of which we are all assembled here to-day to present him with an address, is the result of such awakening and Dr. Coleman has evinced a keen interest in its development and made some of its members co-workers with him in the field of scientific investigation.

I came into intimate contact with him in 1922 when I took charge of the Agricultural portfolio and needless to say that our relations were of the most cordial kind. I knew that he was heavily worked but he never complained of the heaviness of work. More departments were added to his charge, *viz.*, the Sericulture, the Veterinary, the Live-Stock and Amrit Mahal Departments, and in all these departments he showed the same freshness of mind, the same keenness of interest and the same enthusiasm as in his own Department.

His departure at this stage of development of the Department is a distinct loss to the State, but our consolation is that though there might be a corporal severance of his connection with the Department, his interest in the Department which was created by him will never cease and that though far from us, he will watch over its destiny and guide its steps from time to time with useful advice and suggestions. On behalf of all present here, I wish Dr. Coleman long life and an even more prosperous career.

Mr. M. S. Lingegowda of Vasantapur Estate then read the following Address :—

To

DR. LESLIE C. COLEMAN, M.A., PH.D.,

Director of Agriculture in Mysore,

President, The Mysore Agricultural and Experimental Union.

Dear Sir,

On behalf of the agriculturists of Mysore, we beg you to accept this inadequate expression of our regard for you and our grateful appreciation of your valuable services to our country. You came to us seventeen years ago when agricultural work was just being organized in the State, and you brought with you a brilliant intellect, undaunted courage and a radiant hope, which is the strong man's gift from God.

For seventeen years you have given us unstintedly of your best—the treasures of a rich and original mind, an energy which knew no fatigue, and sympathy which recognized no bound or barrier. Whether fighting the *Koleroga* in the dripping areca gardens in the Malnad, or investigating agricultural problems under the burning skies of the Maidan, whether conversing with the *raiyats* in their fields or urging the need for funds and equipment in the high places of the State, you have always been the guardian of the interests of the agriculturists and their honoured friend.

From modest beginnings, the Agricultural Department grew under your hands, branch by branch and section by section, under able workers fired with your own zeal till it became the pride of our State and the admiration of the rest of India. You might justly claim—what one less modest claimed of the French State—"the Agricultural Department, I am the Agricultural Department" ; for you built it up and breathed into it your own spirit of service. The wealth you have won for the people of Mysore and the losses you have saved to them, though great, may yet be estimated ; but the change of outlook you wrought and the inspiration of your high example defy valuation.

Of a man's work with men, it has been justly said that the greatest and most enduring portion is in the heart and the head ; on this view, we may confidently say that your work has been well and nobly done and that the foundations of the agricultural edifice have been truly

and justly laid. The secret of your power with us is your sympathy and that great gift born of sympathy and imagination—the power to put yourself in another's place and realize his point of view. We have known you in our villages trudging cheerfully across sodden fields in pouring rain ; you have accepted of our humble hospitality and entered unreservedly into our lives and interests. Is it any wonder that we have learnt to look on you as one of ourselves ?

We, of the Mysore Agricultural and Experimental Union, have a manifold claim on you. Agriculturists ourselves, we also represent the general body of cultivators and focus their feelings towards you. Ours, besides, is the proud privilege of being your personal friends and comrades. Under your leadership we have pioneered agricultural development by testing and demonstrating improved methods and serving as interpreters of the laboratory to the field ; and it was our earnest hope that in this great work we would have the benefit of your vast experience and wise direction for many more years to come. But circumstances seem to have compelled you to leave us though, we hope, only for a temporary period.

Expressions of sorrow avail nothing and would only sadden our hearts and weaken us when we should be strong. We understand that you go for reasons of health and that it is quite necessary that you should go. We shall only say this that if the affectionate regard of a whole people had the potency to heal, or their earnest wish the power to prevent your departure, you should never leave us and you should always be healthy and strong.

It is now our duty, with all the strength of our hearts, to wish you and Mrs. Coleman and your little daughter a prosperous voyage, a glad home-coming and every happiness that blesses life. And we wish, both for the sake of the agriculture of our country and for the regard we bear you, that you will soon come back to us restored in health and strength.

We remain, Dear Sir,
Your admiring friends,

BANGALORE.
July 3, 1925.

THE MEMBERS OF THE MYSORE AGRICULTURAL AND EXPERIMENTAL UNION.

Mr. H. Srinivasa Rao, Vice-Psesident of the Union, supplemented the Address with these words :—

Mr. Chairman, Ladies and Gentlemen,

On behalf of the Mysore Agricultural and Experimental Union, I beg to say a few words. The feeling of separation that has suddenly come on has been so dominating the minds of the members of the Association and the agriculturists of the State in general that under a heavy mind we are unable to give adequate expression to our feelings. The address which has been just presented contains but a brief account of work done by Dr. Leslie C. Coleman and I am not going to traverse the ground already trodden. I only want to speak a word about the agricultural work done by Dr. Coleman. The secret of success of Dr. Coleman's work lies in the sympathy he enlisted of the agriculturists of the State. His treatment was so kind and the advice and help he rendered so valuable that a man who once spoke to him became a sympathizer with him and carried out anything he suggested in an enthusiastic manner. His object in establishing the Agricultural and Experimental Union, was to demonstrate the established truths of Agriculture in the ryot's own field and at his own cost, with a view to bring better methods to the ryot's mind and thus help to spread the knowledge of Agriculture rapidly and without additional cost to Government in the way of establishing demonstration farms for the purpose. This is a unique association the like of which is nowhere to be found in India and it has done valuable work.

As President of the Union, Dr. Coleman has guided its work from the beginning since its establishment in the year 1918 and the members feel that his departure at a time when more valuable work is about to be done, is a great loss to the State. They, however, hope that he may return with renewed health and vigour to guide its destinies for a long number of years to come. I need only add that Dr. Coleman's love of Mysore and its people is genuine and his zeal for agricultural improvement is greater than that of any born Mysorean.

On behalf of the organizers of the Bangalore District First Sericultural Conference, Mr. B. Abdur Rahman, B.A., President, Bangalore District Board, presented a copy of the "Silk Song" printed on Mysore Silk to Dr. Coleman.

Mr. T. Narasinga Rao. Coffee Planter. Chikmagalur, expressed the deep debt of gratitude the coffee planters owe to Dr. Coleman for his untiring and presistent efforts in trying to improve the coffee industry.

Dr. Coleman's Reply.

"Mr. Humza Hussein, Members of the Mysore Agricultural and Experimental Union, Ladies and Gentlemen,

The address with which you have honoured me has moved me most profoundly. While it is much too flattering to me in its references to the work which I have done since coming to Mysore, still it is a great satisfaction to me to know that in your eyes at least seventeen of the best years of my life have not been wasted.

I joined the Mysore Service on the 5th January 1908. At that time there was no Agricultural Department in this State. There was a minor Department of Agricultural Chemistry directed by Dr. A. Lehmann, an Officer who devoted ten years to the service of this State and whose invaluable pioneer work has, I think, not been adequately recognized. That, however, is frequently the fate of pioneers. Dr. Lehmann had under him a mere handful of assistants and the whole budget of his Department, I believe, did not amount to Rs. 50,000.

My first work in this State had to do with the investigation of certain serious plant diseases and insect pests which were responsible for very heavy losses but unfortunately for me within less than a year of my arrival in Mysore Dr. Lehmann left the service and I was called upon to direct the combined activities of the Department of Agricultural Chemistry and the newly formed subordinate Department of Mycology and Entomology.

To any one who thought at all seriously about the development of this fair State even in those days which now seem so far away it must have been quite obvious that the development of agriculture must be one of the most important questions to be considered. Mysore was then and still remains essentially an agricultural country. I for one believe and hope that it will always remain so. The very thought of an industrialized Mysore with her sturdy peasantry drawn to large cities and housed in slums would fill one with most

profound depression were there any indications that such a terrible fate would befall us.

Very shortly after I took charge of the agricultural work in the State I was asked by the Dewan Mr. T. Ananda Rao —that patriot and true gentleman who has passed from our midst— what I considered to be necessary for the development of agricultural work in the future. I impressed upon him the fact that development of agriculture in this or any other State must be based on the solid foundation of scientific investigation. I pointed out further that no one man could possibly investigate more than a small fraction of the problems which Mysore agriculture faced, even had he the superhuman ability to fit him to do so. I, therefore, urged upon him the necessity of giving men who had, after preliminary employment in agricultural work, shown their capacity, the very best foreign training possible. Lastly, I assured him that I was prepared to devote the rest of my working days to the task of helping to establish in this State an Agricultural Department manned by Mysoreans which would endure and which would be able to deal in an adequate manner with the problems facing the State's main industry. I was aware then and I am even more keenly aware now that agricultural improvement is a thing of slow growth. I have never for one moment been deluded into the expectation that even under the most favourable conditions I should, in the few short years I could spend in this State, be able to witness more than the first fruits of our work towards the improvement of Mysore agriculture.

The policy of training young men with local experience to take up responsible posts in the Agricultural Department, which was inaugurated during the Dewanship of Mr. T. Ananda Rao, has continued ever since. The development of that policy has, for one reason or another, not been nearly so rapid as I should have wished. Nevertheless Mysore State can, I think, now boast of an Agricultural Department with the best trained scientific staff of any Agricultural Department in India. Feeling as I have always felt that the greatest service which I could perform for this State was the laying of foundations I have always tried to keep in front of me my great responsibility in recommending men for appointments not only for higher posts but for the more subordinate posts as well. I have further tried to impress upon men who have been associated with me the value of

independent thought and initiative and I have endeavoured to give to these men an opportunity to produce the best that is in them. I have always had a particular loathing for the big stick of disciplinary action as applied to men engaged in scientific work, for it has been perfectly obvious to me that a man in whom the fire of service has not been kindled, cannot be made to produce results of any real value under the club of discipline. I count as one of the greatest blessings of my life that I have been associated during the past seventeen years with true and loyal men, who have done their duty to the State under conditions which have at times been very difficult. Many of these men have shown an ability for independent thought and action which has astonished me. To them more than to me belongs the credit for any reputation which the Mysore Agricultural Department may possess. Whatever may happen to me in the future the memory of my relationship with these men will endure.

In your address, you have spoken of my relationship to the agricultural population of the State of which the members of this Union are leading representatives. A foreign officer necessarily labours under a heavy handicap in his direct dealings with agricultural classes in any part of the world and I would not for a moment suggest that I had not felt that handicap. However, a fairly close association with agriculturists on three continents which extends back to my early boyhood has convinced me that the aspirations and the outlook on life of agriculturists all over the world are fundamentally the same at least as regards the occupation from which they gain their livelihood. In attempting to introduce agricultural improvements one encounters the same kind of difficulties in Mysore as one encounters in Canada. It is true that these difficulties are greatly accentuated here by the fact that our ryots are still to a great extent illiterate and that traditions extending back over many centuries make them much more difficult to move from the beaten track. However, the same general methods must be used in both countries if success is to be attained. Mutual confidence and respect must be the foundation upon which any permanently valuable work is built and that confidence must in turn be based upon sincerity and honesty on the part of agricultural workers. There is no room here for the flashy and sensational methods of the charlatan. These may appear to succeed for a short period but the shrewd common

sense of the ryot will, sooner or later, enable him to pierce through the tinsel and sham. You assure me that the departments which have been placed under my charge have been able to gain from the Mysore ryots some measure of that confidence which is essential to success. No one, I think, realizes as I do how slowly and painfully that confidence has been gained nor how long the journey is which still lies ahead of us. The members of this Union have played a very prominent part in establishing this mutual confidence and respect. I need hardly tell you how much I personally have valued your support in the past and how increasingly valuable that support to these departments will be in the future.

May I return for a few minutes to the history of agricultural work in the State ? It is sometimes forgotten that while work in connection with agricultural development has been going on now for almost 27 years, an organized Agricultural Department has existed for scarcely twelve years. The Government Order approving of the organization of an Agricultural Department was issued in February 1913 but almost a year elapsed before that order could be brought into effect in its entirety. A large part of our scientific work and practically all of our demonstration work in the various districts of the State are therefore children of no more than eleven years. That we have been able to do as much as we have done in this latter field is due on the one hand to loyal and capable officers and on the other to the self-sacrificing co-operation of members of this Union and other agriculturists of the State.

I should be indeed ungrateful did I not here pay my respectful and humble tribute to the gracious and deep interest which our beloved and revered ruler His Highness the Maharaja of Mysore has taken in the work that has been placed in my charge. That interest has been one of my chief sources of inspiration and consolation during periods of depression which I suppose come to every man. I should like also to pay tribute to those patriotic statesmen under whom I have had the honour and privilege of serving in the past. It would be presumptuous on my part to attempt to add laurels to their crowns. I should, however, like to pay my tribute to men like Mr. T. Ananda Rao, Sir M. Visvesvaraya, Sir M. Kantaraj Urs, Mr. H. V. Nanjundayya and Mr. P. Raghavendra Rao under whom I have at different times served directly. Their services to the State are well known but their

services to Mysore agriculture have, I believe, not received that recognition which they deserve. I should like to pay my tribute to our honoured Chairman Mr. Mir Humza Hussein under whom I had the honour of serving for over three years. I shall never forget, Sir, the close association which I was privileged to have with you nor the confidence which you were good enough to repose in me. Your practical interest in the development of the State's main industry and more especially of that industry in the Malnad has marked you out as a true and patriotic statesman and your efforts in this regard will, I am sure, never be forgotten.

During the past eleven years there has been slowly but steadily built up in the State in the Agricultural and relative departments an organization which should in the future prove capable of dealing with most if not all of the problems which face Mysore agriculturists. The Civil Veterinary Department is dealing in as efficient a manner as funds will permit, with the serious cattle diseases which are so prevalent in this country and which levy so heavy a toll on our main sources of agricultural wealth. The Sericultural Department has been and is doing work of the very greatest value towards the development of our main subsidiary agricultural industry. The Agricultural Department itself, with its sections of general agriculture, agricultural chemistry, mycology, entomology, economic botany,—engineering, agricultural education and live-stock, has at least the skeleton of an organization capable of dealing with our main agricultural problems. Lastly, the transfer of control of the Amrit Mahal Department should make possible the utilization of what is for India a unique herd of draught cattle for the development in this fair State of the best draught stock in India.

In this connection I feel compelled to refer to a painful subject. We are as you are aware about to lose the services of Mr. Davison, our Live-Stock Expert. Mr. Davison came to us little over five years ago. Since he came here he has had to tackle problems which from an agricultural standpoint are of the first magnitude. In the nature of things progress in live-stock improvement must be slow, yet in this short period of five years he has been able to establish on sound and, I trust, permanent lines work on the improvement of both cattle and sheep which should in the future enrich the agriculturists of this

State by many crores of rupees. His ability is unquestionable. His industry and devotion to duty have been rarely equalled. His loyalty to me personally has been without flaw. I look upon his loss as an irreparable one to the State. On your behalf and my own I wish him a happy and prosperous career.

Let us now turn to the future. The development of agricultural work in this State is being handicapped at present and seems likely to be handicapped for some years to come by the same factor which is handicapping all development in the State -the lack of funds. It has personally seemed little short of a tragedy to me that just when our scientific work has begun to yield results which are of incalculable value to our agriculture adequate funds are not available to expand that scientific work and to introduce those results in a rapid manner throughout the State. If we take the long and statesmanlike view, however, this is not a matter of fundamental importance. As I have already said progress in agricultural improvement is certain to be slow and while this check to our activities undoubtedly prevents us at present from enabling Mysore ryots to increase their wealth by many lakhs of rupees, looked at from the point of view of a hundred years which in itself is no great period in the development of a nation's main industry, a check of a few years, however disheartening to the actual workers involved, may be looked upon as of comparatively insignificant importance. The more real danger arising from this condition is that the men engaged in the work may lose heart and that that divine enthusiasm which should actuate every scientific worker may be deadened or be altogether lost. I can think of few more useless impediments to a State than an Agricultural Department whose fires have been quenched.

The other danger to which I would like to refer is the danger that the relative importance of various branches of the department's activities may not be duly recognized. The natural tendency in human nature is to recognize the value of the obvious and the external. Now in the work of the agricultural and sister departments the things of obvious value are the results which have been and are being demonstrated to the agriculturists of this State and which have already enriched them by many lakhs of rupees. It is perhaps somewhat difficult to realize to the full that these results have been obtained

only after prolonged scientific investigation and experiment. In both our representative bodies, the Legislative Council and the Representative Assembly, there has been for many years back a fairly steady insistence on the importance of increasing district staff and providing more funds for direct work among the ryots. On the other hand there has been much less evidence on the part of our non-official legislators of interest in the development and expansion of scientific work upon which the district work must depend for its success. I should like here to utter a most solemn warning. If our scientific work is starved, no matter how much money is lavished on demonstration and propaganda, the Agricultural Department and its sister departments will die and their work will come to nought. To you, Gentlemen, Members of this Union who through the work conducted on your own fields and through your close association with the Agricultural Department are in a position to appreciate better than others the paramount value of scientific investigation, I would like to give the very special and sacred duty of holding aloft the torch of science in our popular assemblies wherever they are held. If you do not do this I fear as years go on—and an increasing power of self-government may be given to the people of this State—the supreme value of scientific work may be overlooked and the structure on which we have spent so many and laborious years in rearing will crumble to the dust.

This is the fifth time that I have been compelled to drop my work in Mysore and return to my native land. Each parting from friends here has been a time of real sorrow to me. None, however, has had the poignancy of the present moment. In leaving you I leave most of my life behind me. If the words of your address come from your hearts as I feel they do, if they are more than a mere expression of respect, if they represent a real regard and affection for me I would most solemnly enjoin you to support the hands of those who are left to carry on this noble work. I believe you can in no other way do more noble service to our beloved and revered ruler and to the fair land of Mysore which has given you birth.

In conclusion, I wish to thank you most sincerely for the generous words of appreciation which you have expressed to me—words, which are, I realize, much too flattering to me. I wish further to thank you

on behalf of my wife and myself for your good wishes and to assure you that I personally look forward with hope to the time when restored to health I may again be associated with you in the work of developing the prosperity of this fair State."

Dr. Coleman, Mr. W. Davison and the Chairman were then garlanded. Three Cheers to His Highness the Maharaja, Dr. Coleman, Mr. Davison and the Chairman were called and responded to. The meeting then dispersed.

Agricultural Co-operation with Special Reference to the Bangalore District.*

BY

A. K. Yegnanarayana Iyer, M.A., Dip. in Agri. (Cantab.), N.D.D., etc.,

Deputy Director of Agriculture in Mysore.

The subject of Agricultural Co-operation and the scope there may be for one or other of its many forms in the different parts of our State have been so often discussed in numerous Co-operative Conferences, large and small, that it should be quite familiar to an audience such as we have to-day. If, nevertheless, we return to it again it is because that notwithstanding our efforts, we have little to show by way of any conspicuous success in the matter of Agricultural Co-operative Societies and feel that the subject will bear frequent investigation. I beg leave, therefore, to place before you a brief survey of this subject so far as it may relate to the Bangalore District.

Agricultural Co-operative Societies are, as you are aware, formed for the following purposes :—

(1) For the supply of seeds, manure, implements and other articles required by the farmer such as concentrated feeds for stock.

(2) For the sale of the produce grown by the members, whether it is grain, fruit, milk, eggs or poultry or live-stock.

---

* Paper read before the Bangalore District Co-operative Conference on the 28th March, 1925.

(3) For the co-operative ownership and use of large-scale appliances which may be too big for individual ownership, such as power gins, power-driven sugar-cane mills, irrigation pumps, threshing machines, rice hullers, fodder cutters, spray pumps, etc.

(4) For the purpose of serving special forms of farming, such as dairying, sericulture, etc.

(5) Colonization and co-operative farming.

(6) Insurance against loss of stock or crops by sickness, storm or pests.

Excluding the last two as too remote for practical realization here, we shall take each one of the others in order and examine the scope there may be for them in this District.

Supply Societies.—The Supply Societies deal with the joint purchase on a large scale, of farmers' requirements by way of seeds, manures, implements and feeds and sale in retail to members. By making a large purchase composed of the likely indents of individual farmers, wholesale rates and favourable freight terms are expected to be secured, which cannot be secured except through such co-operation. These supply societies are merely co-operative store societies which are considered to be the simplest form of co-operative societies next to ordinary credit societies. For the same reason the scope for such societies deserves our first consideration.

Firstly with regard to Seed Supply Societies.—(*a*) Seeds. As a general rule seeds of ordinary agricultural crops do not in our country form an article of trade ; each farmer keeps usually seeds enough for his own requirements out of his own produce. Ragi, jola, the different pulses and oil-seeds all come under this category. It is only when crops have been poor or have failed or when a resowing has been rendered necessary that seeds have to be purchased. In normal seasons and with all ryots of ordinary means the rule holds that seed is seldom bought. The only agricultural seeds of any importance which form an exception to this rule are cotton and potatoes ; as far as Bangalore is concerned, cotton may be left out of consideration because Bangalore is not a cotton district. Potatoes, however, form a very important article in the seed trade and are somewhat unique in that the seed is very costly, as the quantity required for an acre costs about Rs. 100 on an average. This high cost necessitates the

actual grower to enter into some form of a credit transaction with the supplier for his seed supply. A certain amount of fitful demand exists for the seeds of pulses like avare and togari and a somewhat insignificant one for the seeds of vegetables. In special seasons a demand also arises for certain special varieties of seeds, such as early maturing paddy and groundnuts : for special high yielding strains like the new H 22 ragi, a demand arises in villages where these are being newly introduced. But within the limited sphere of operations of any rural co-operative societies the demand for any of the above kinds of seeds will not be large enough for the purposes of a regular store society dealing only in seeds. Seeds will have to constitute only a small portion of their stock-in-trade. A limited supply of seed of all these kinds may, however, be recommended for all rural societies agreeing to take up the work, while in the case of societies in the Devanhalli Taluk and societies in potato-growing villages elsewhere, seed potatoes may also be included.

Secondly as regards Manure Societies.—(*b*) Manure. Almost the only manure known to the ryot, *viz.*, cattle manure, is not an article which lends itself to commercial handling and may be therefore left out of account for the present purpose. Only special manures like oilcake, bonemeal, sulphate of ammonia, superphosphate, etc., can be thought of in this connection. Although in many parts of the State, these manures are unknown and a demand has got to be created by demonstration and propaganda through the Agricultural Department, Bangalore has the distinction of being a District where the work of the Agricultural Department has already created a fairly large demand for all these fertilizers. Oilcake manure for sugarcane is very well known and is largely in demand. Sulphate of ammonia is rapidly coming into use for the same purpose and superphosphate and other manures both by themselves and in the form of mixtures for paddy, potatoes and fruit trees are also coming largely into use. While oilcake is in demand throughout the District in all villages where sugarcane is grown, for the others the demand is just now much localized. For the paddy manure, the biggest centre is Hoskote, for sulphate of ammonia it is Doddaballapur and for all general mixtures Bangalore itself is a good centre. In these, manures may constitute an important part if not the whole stock-in-trade of Agricultural Co-operative Societies.

Thirdly as regards Implements.—(c) Implements. The important agricultural implement which is an article of trade is the improved plough. The Bangalore District leads in the matter of the large popularity of these ploughs and Bangalore and Anekal Taluks are very notable in this respect. It is no exaggeration to say that there are some villages in these taluks where one such plough can be seen in practically every ryot's house. In these taluks at least there is considerable scope for the sale of such ploughs through Co-operative Societies. Recently, moreover, certain rules have been framed by the Agricultural Department to enable societies to purchase ploughs at a small reduction in price which is an important consideration. But I should like that the implements for stocking and sale in Co-operative Societies should not be limited to this article, the improved plough. In addition, a number of other appliances like shares for the country ploughs, kunte blades, hatchets, spades, pickaxes, sickles and such other things as the ryot buys in the local *Santhes* or at his own village forge also form fit articles for sale in societies. In rural societies, as in the case of seeds, these can constitute only a side line.

(c) *Feeds.*—As regards the stocking of concentrated feeds, the only place where this assumes some importance is the city of Bangalore itself, where there is a large number of dairymen engaged in the city milk supply, keeping very good animals and spending considerable sums in their feed and upkeep. Should at any time these men can be brought together to form a special co-operative society for themselves to finance their purchase of cattle, to rent pastures, to own their own fodder yards, to buy feeds and fodder wholesale and so on, then only can these articles become important from the co-operators' point of view. But even in rural societies, I consider that business of some magnitude can be done if feeds like cotton seed and rice bran are stocked for sale.

As a general observation in regard to these Store Societies, it may be mentioned that there does not exist what may be called the incentive or force of circumstances from which the desire to start and work such store societies will naturally arise. For reasons explained already, there is not such a large trade in any of the articles worth taking up by any individual or organization in any one village

or group of villages ; there is, therefore, no middleman walking away with the profits which ought properly to go into the pockets of the ryot, a result which a co-operative society is calculated to bring about ; furthermore, in the case of certain articles like manures, there is not, at present, such a great difference between rates quoted for large orders and small orders as to confer any decided advantage on a large combined order such as co-operative societies can place.

The scope for the formation of store societies should not, however, be deemed little, because of the above circumstances : they are both of a temporary nature and, I think, will soon cease to exist as the demand increases for these articles. Even otherwise, of the benefits of such a society properly worked, one need not have the least doubt. If, by the joint credit of a society, the members can obtain their supplies of manures, implements or seeds at their door, at the right time, and, if need be, on credit, no better step can have been taken for the improvement of the agriculture of the country. The ryot, more than the trader or artisan, requires credit of long duration of at least one crop season and as a loan through such a society will not be in the shape of cash but of commodity, one important safeguard at least would have been taken to see that the loan is put to productive investment.

Societies for Marketing Produce.—Taking now societies for the joint marketing of produce, we come to a field where there is probably all the incentive for co-operative action that one may need but where the difficulties are also great. The merchants' profits, perquisites and nibblings at the *mandees*, non-regulation weights and measures, delays, petty levies and *mamools* and even combination among merchants which fetter the freedom of the ryot to sell where he pleases,—these features of marketing at the present time are too well known to need description. To add to these is the ryot's necessity to sell his produce as soon as it is ready, *i.e.*, at a time when prices rule low, and his inability to hold it up till prices improve. One does not forget what is often adduced *per contra*, *viz.*, that the scramble for the custom of ryots among the merchants is so great that, far from there being any tyranny from the latter, the ryots are, on the other hand, offered substantial inducements ; that merchants' profits are cut very close indeed being not more than what the ryots will have to pay if they, as a co-operative society, conducted the business

themselves, that the ryots are getting to know a few things and are able to drive a good bargain without incurring any risk at all. All these may be true to some extent but the normal state of things is, however, such as to furnish as strong an incentive as may be desired for the ryots to combine. If a ryots' co-operative society can be organized through which produce of all members can be collected, stored and sold to the best advantage and members advanced money against their produce pending full settlement after complete sale, a most beneficent step would have been taken ; but I am afraid that the difficulties in the way are formidable. For one thing to be of real use, such an organization should be large and only a central organization in Bangalore itself can undertake a task of that magnitude. The requisite managing talent will be very difficult to obtain and can be found only in the very set of merchants against whom such a movement is admittedly directed ; an initial failure to obtain as big a price as through a private agency will strain the loyalty of the members, upon which alone given in unstinted measure, the success of such a society depends. But if a society can be formed anywhere at all, it can be only in Bangalore. I have heard the subject mooted by more than one agriculturist that they would guarantee to send their produce, be it rice or jaggory or coffee or perishables like fruits or eggs to a central society if the latter would undertake to sell the sa e advantageously for them. The matter of a central co-operative store buying from these people and distributing to the various customers' societies in Bangalore is worthy of consideration. These latter societies purchase in the aggregate very large quantities of produce of different kinds and will be able to absorb the output of the members undertaking to supply their produce. I know that the fate of a society which was formed on similar lines some time back and which has had to be wound up will be called to mind by many amongst you, as a warning against similar ventures ; but I doubt if the case is on all fours with that of a society of the kind proposed and even if it should be, whether the failure was not due to causes which could have been avoided.

The produce which figures prominently in connection with sale societies in Europe and America and which bulks largely in text-books on Agricultural Co-operation is principally eggs, butter, vegetables and fruits. The situation in this respect here is this : As regards

eggs and butter Bangalore may be said to be the central emporium into which almost the entire output of this District as well as the neighbouring taluks converges ; and although in the aggregate very large quantities arrive in the City these are derived from individual supplies which are exceedingly meagre, so much so that the men engaged in collecting these small supplies for delivery to the merchants in the weekly *Santhes* make little more than cooly wages. The case is quite similar in the case of butter also, a whole village not furnishing as much as a single ordinary farmer in Western Countries. In neither case, I think, can it be said that the middleman is waxing fat at the expense of the ryot on the one hand and of the consumer on the other.

In the case of fruits and vegetables too, one hears complaints often from growers that the prices secured by them are hopelessly inadequate, sometimes not even covering the cost of haulage to the market and that the trade is practically in the hands of a small group, if not a single individual, through whom alone sale at any price at all is possible. There is certainly truth in these allegations, but I am afraid the case for any experiments in starting any co-operative society for this purpose is even more hopeless, as we deal here with a highly perishable produce, with all the special risks incidental to it. As a general observation in regard to produce societies, it may be stated that it is a most difficult undertaking, would require a very efficient organization and all the special care which the Co-operative Department itself can bestow. In fact, I do not know if there are any successful produce organizations in the country. An areca sellers' society and a copra sellers' society were, I believe, started, but I doubt if they ever worked ; at any rate, the published reports record no progress. Outside our State in the Nilgiris, a potato-growers' society is said to have been working which is claimed to have broken the tyranny of a ring of middlemen and secured to growers a freer and a better market. It does not, however, figure much in reports lately. An auction depot for the sale of cotton was organized by the Bombay Department of Agriculture at Dharwar to enable ryots to obtain a better price for their superior variety of cotton than could be secured with the local brokers. Similar auction sales are also reported in the Punjab. These, however, are not regular co-operative societies. They, however, show what can be done by combination.

Societies for joint use of Machinery and Appliances.- Coming now to societies for the joint-ownership and use of appliances, the appliances that come in this category are large-scale appliances too costly or too large for individual requirement or ownership. Many of these will have to be tested in this country and certified to be suitable and considerable demonstration work by the Agricultural Department will also have to precede their being recommended to co-operative societies. The use of the engine-driven ploughs is one such but such success as this has attained is only in the black cotton soil area. Bangalore has no such tract of any importance, and until its profitable use on the soils and conditions of this District is demonstrated, we may leave it out of consideration. The installation of pumps and engines to lift water for irrigation either from large wells or rivers for the benefit of a number of ryots as a co-operative concern is a promising line ; it is also long past the experimental stage ; but as far as I know, water sources of the kind necessary for large outfits serving many ryots, do not exist in this District. The fact that this District is traversed extensively by the electric power lines is, however, an advantage worth exploiting in this connection, if not for large pumping installations, at least for moderate ones.

Co-operative Societies for the running of power-driven sugarcane mills and jaggory boiling appliances offer some scope for useful work in several villages of this District. As a matter of fact more outfits of this kind are in use in this District than anywhere else. The present installations are, however, owned by individuals who are large sugarcane-growers. Owing to the bad seasons we have been having, there has been great shrinkage in the area under sugarcane in these villages in consequence of which the outfits have not had as good a chance as they would have otherwise had. The possibility of profitable use has, however, been demonstrated and the field may be considered in that respect at least prepared for co-operative action.

In this same connection, there is very great scope for the co-operative ownership of even the ordinary bullock-driven sugarcane mill and jaggory boiling appliances. We have been striving hard to induce not only existing credit societies to invest in these outfits but also to persuade villagers to start, if need be, special societies for this purpose. Our efforts have met with very gratifying results and I commend it here to you all as a very suitable line of work for

societies in or about sugarcane-growing villages. By investing in such an outfit, a society will merely take the place of the private individual who now owns and hires out these appliances and earns profits from the very clientele which the society would serve and thus divert the custom and the profits to itself. It thus constitutes a most natural development along orthodox co-operative lines. Two societies already own mills, *viz.*, Ramohalli and Bukkasagara in the Bangalore and Anekal Taluks respectively and before another two seasons are over, these mills will become the absolute property of the society, the whole cost being paid up solely out of the hire earned from the mills each season. The Jakkanhalli Society, Nelamangala Taluk, has applied for a mill and a pan and a few more societies have passed resolutions to that effect and may start work if not in this season, certainly in the coming one.

Power-threshing machines are also in use by certain individual farmers and deserve consideration as fit appliances for co-operative use. Rice-hulling machinery is another large-scale undertaking to be recommended for work on co-operative basis, but Bangalore is not a district which offers much scope in this direction, for there are few villages where paddy is an assured crop year after year on any large scale with the possible exception of Hoskote.

One general remark which can be made in respect to societies of the above kind is that already there is much co-operation among the villagers in carrying out many of their operations, be it in the field, on the threshing floor or in the cane-milling shed, or at the irrigation channels; to that extent the conditions may be said to be favourable. A spirit of independence, the spirit of each man for himself, is, however, strongly manifesting itself in the villages, a deplorable sign which has nevertheless to be reckoned with. The introduction of large-scale appliances of the above kind and a demonstration of the definite advantages they confer on the community will perhaps serve to arrest the progress of this disruptive force.

Other machines and appliances which, though they may not be considered large-scale ones in the same sense as those dealt with so far, but are yet fit for use co-operatively and which can be profitably used by many ryots are: (i) disc harrows for preparing land quickly for sugarcane, for disking in cocoanut gardens and even for light

ploughing ; (2) pressure sprayers for spraying against insect pests and plant diseases which are only too common and which can be kept in check and much loss avoided by timely spraying with the proper spray materials ; and (3) fodder cutters for chaffing jola, sann hemp and such other coarse green fodder. All of these can be kept for hire in the first instance, just like the sugarcane mills mentioned already.

Coming now to *Co-operative Societies serving special types of farming like Dairying and Sericulture*, a brief reference has already been made to the dairymen of Bangalore City. As regards sericulture, the Bangalore District and especially the Channapatna and Closepet Taluks constitute an important silk tract. Both these two interests, *viz.*, dairying and sericulture, have in other countries greatly benefited by the co-operative movement. As the work of societies formed for such purposes will relate to affording credit to the supply of requisites, the sale of produce and the joint use of appliances each in respect of the articles appropriate to itself, the observations made already will apply to them also in a general way.

I have briefly sketched above the various directions in which there is scope for the formation of agricultural co-operative societies, the facilities there are for each and the difficulties that will have to be faced. Setting aside the more ambitious ones for being taken up as more experience is gained in this special work, I would indicate now one form of societies on which we can start work straightway.

These are societies in the nature of store societies ; they will, in the first instance, be formed in places where there are already good credit societies working. They will stock generally such articles as are stocked by the Depots of the Agricultural Department, they will deal in all ryots' requirements such as seeds, manures and implements. As regards implements they will purchase some improved ploughs, cultivators, spare parts and local tools and appliances ; as regards seed they will buy the best grown ragi or jola of the strains recommended by the Department and grown by the members ; they will, if it is a paddy village, buy some of the short-duration fine varieties in addition to a certain quantity of the variety usually grown by them ; they will also buy some pulses, such as avare and togari. Artificial manures like sulphate of ammonia, paddy manure, potato manure, and so on, will also be stocked ; if it is a sugarcane village, a mill and

a pan will also be owned, also a spray pump for plant disease work. All purchases will be made as far as possible after ascertaining the requirements of the members and with the advice of the Agricultural Inspector whose co-operation ought to be secured at every step; the sales will be both to members and to outsiders. The Agricultural Inspector will also bring such cash orders as he may canvass in the neighbourhood to be filled in by the society. Sales will be for cash and for credit—prices will be so fixed in consultation with the Agricultural Inspector as to make the society earn a small interest of at least 6% as the result of all the transactions put together, *i.e.*, sale of materials, hire of mills and pans and other appliances. A capital of Rs. 2,000 will be deemed sufficient in the beginning for such rural societies.

Should separate agricultural societies be formed for this work or can it be entrusted to ordinary credit societies already in existence is a question asked in this connection. A separate society will certainly be the ideal to aim at; it has the advantage that the interests of all the members will be alike in contrast with the credit society where often the bulk of the members are merchants, money-lenders or others who are indifferent,if not quite opposed.to the idea of taking up this work; their staff cannot devote the time necessary for the work, there is not enough storage accommodation for these articles; the idea does not altogether appeal to them. A more important consideration is one of funds; a credit society is unable to set apart the capital necessary for this work. Their funds including the so-called reserve is all utilized as working capital, which even then is found insufficient for their credit requirements. Further, credit transactions earn a higher interest than this business is ever likely to yield. For these reasons a separate society with sufficient funds, enough if need be even to give out small loans for the purchase of articles not available in the agricultural societies,will be the best thing to aim at. The difficulty, however, in the villages is to find the proper persons capable of managing even a credit society itself. In view of this great difficulty in the early stages at least when the bulk of the business will not be great it may be well to entrust the work to the credit societies provided they are willing to take it up, and separate funds placed at their disposal for the special work as loan if the reserve fund cannot be made available. As a matter of fact, the bulk of the

agricultural work, *i.e.*, sale of implements, seed and manure done so far through co-operative societies, has been only through the existing credit societies on the principle that half a loaf is better than no bread. The possibilities and the need for separate societies should, however, be kept in view and efforts made to bring them into existence where the requisite facilities may be forthcoming ; if such a store society can also undertake the lending of money for the period of a crop season to its members solely for agricultural purpose, it will be the most powerful lever for the uplift of our agriculturists.

Results of Experiments Regarding the Comparative Merits of Propagating Pepper by means of Cuttings got from Top *versus* from Bottom of the Mother Vines. *

By

Thenginakere Subrahmanyabhatta.

1. The vines propagated from top cuttings require greater care.

2. Vines from top cuttings begin to bear very early, *i.e.*, within a year of their planting in their permanent places while other vines take about three years.

3. The vines from top cuttings are somewhat late bearers maturing their fruits in April, while the other variety does so in March. Fruits of the latter drop off easily from their bunches as soon as they ripen while those from top cuttings do not so shed.

4. *Nature of Bunch.*—In the vines from top cuttings the fruits are more numerous and are closely set in the bunch and in the others fertilization is less and fruits are further apart. The fruits in the latter are, however, a bit bigger in size.

5. *Yield of Crop.*—The quantity of pepper produced by the vines from top cuttings is about 3 seers as against $1\frac{3}{4}$ seers got from those of the other type. The above decidedly show the advantages of propagating pepper from cuttings taken at the top.

---

* Received from the Director of Agriculture in Mysore, for publication.

NOTES AND COMMENTS.

Our President.

For the sake of his health, our beloved President Dr. Leslie C. Coleman, M.A., Ph.D., was obliged to go on long leave early in July. The non-official members of the Union organized a meeting to present him with an address and thereby show their appreciation of the work done by him. The address as well as the President's reply to it are printed elsewhere.

A few points in the reply of the President are worthy of note. He pleads and pleads justly for support from the members to do all they can to help the Scientific Sections of the Agricultural Department to carry on their investigation work. It is made clear that all demonstration work must be based on results of accurate experiments.

Another important point touched upon is the industrialization of an agricultural country like Mysore. It is quite right that agriculture must remain the chief industry of the State. Under no circumstances should industries be developed *at the expense of agriculture.* But we are of opinion that too many are at present dependent on agriculture alone for their living. Considering the fact that the country imports a great deal of the necessaries of life from abroad, it is highly desirable to establish some industries at least to make use of all available raw material of the country.

Moreover, the agricultural classes are not earning enough to enable them to lead a decent life according to modern standards of living. It is absolutely essential to increase the earning capacity by having recourse to some subsidiary industries. One such important subsidiary industry is sericulture and all attempts are being made to improve the condition of that industry in the State.

Another industry which requires less capital and is less risky than the silk industry is hand-spinning and weaving. During our stay in Germany we were surprised to see hand-weaving being done by many farmers in their leisure hours. When such a thing is possible in a highly industrialized country, we see no reason why it should not be taken up here also by our agricultural population. [B.N.I.]

* * * * *

Live-Stock Work in Mysore.

Our President has only left us temporarily but our Live-Stock Expert has left Mysore for good. Our members are quite aware of the good work started on sound lines by him for the improvement of live-stock in Mysore. It is a great pity that Mr. Davison had to leave us before tangible results could be shown from his work. This country is not so much in need of improvement of the breed of draught animals as that of milch cattle. As a rule, our cows are poor milkers and it does not generally pay to keep them. What Mr. Davison has done to improve the strain of milch cattle of the country can very well be seen on the Palace Dairy Farm at Rayanakere, near Mysore. A few figures in this connection might be interesting to our readers. There are at present some Scindhi Holstein crosses in their first lactation and are yielding between 130-175 lbs. of milk per head per week, whereas pure Scindhis in their first lactation are giving only 85-106 lbs.

In addition to work on stock-breeding Mr. Davison has laid out an excellent fodder farm at Rayanakere. Making of silage is also a regular part of the work on that Farm and milch cattle are being fed on silage during summer months when succulent fodder of any kind is scarce.

Besides making silage in towers and pits on the Farm, Mr. Davison started making pit silage in some districts also with a view to popularize it in the Malnad.

Another line of work on which Mr. Davison was very keen was the improvement of sheep and the Kolar Sheep Breeders' Association is the result of his endeavours.

It is a great pity that Mr. Davison found no time to contribute an article to the Journal on his work but what has been done till now can be gathered from the annual reports of the Agricultural Department. [B.N.I.]

* * * * *

Agricultural Costings in Switzerland and Denmark.

Interesting results relating to the economics of large and small holdings in Switzerland and Denmark, gathered together by Dr. A. G. Ruston, Travelling Research Fellow of the University of Leeds, have been furnished in the *Journal of the Ministry of Agriculture*, July and August. While the problem has been studied from the

standpoint of the requirements of England, it is not without interest to those who have the progress of Indian Agriculture at heart.

The accounts of the farms investigated have been kept on the extensive rather than the intensive system. There was no separate account kept for each branch of farm work. Receipts and payments whether in cash or kind were entered in a cash book. Payments made in kind to the household or farm staff were also entered. Accounts have been kept in this way of no less than 6,057 holdings in Switzerland. The conclusions based on data so extensive cannot but reach a high standard of accuracy.

The first table given is not of much interest to us as it gives the cost and return per acre as affected by the war. The second table gives comparative results in regard to large and small scale farming. It shows that while the gross yield is the highest per acre on the small farms of 12½ acres and less, the higher production costs reduce the net earning by about 50%. Efficiency decreases as the holding goes below 30 acres.

The thirty-acre farm so common on the continent is nowhere found to be the most economic unit. There is no question that small size farm judging from the larger number of hands they seem to require will help towards a solution of unemployment better than large estates. But this social advantage is counterbalanced by the handicap of high capitalization in the form of non-productive capital, by the high working cost and by the uneconomic employment of labour. It is not surprising, therefore, to find that there has been during the past seven years an annual deficit of 4 shillings per acre on holdings under 25 acres. The efficiency level indeed seems to swing between 75 and 100 acres on which a surplus of 30 *sh.* per acre was obtained. The efficiency of the small farms falls so rapidly as the areas decrease that from the point of view of income a man would be better off as a labourer than the cultivating owner of a farm of 12 acres or even 25. On the moral side it need scarcely be said that the advantage is all the other way.

The superiority of the small holder comes in the matter of livestock where he is in a far better position to pay individual attention to the animals. In fact, the smaller farms have more and better livestock than the large estates. He almost exclusively relies on the

sales of produce of animal husbandry for revenue. He manages his grass land better and the corn land worse than the large producers.

These are certainly interesting results and one cannot help thinking that similar investigation in this country would be as interesting, if not more. [K.K.K.]

* * * * *

The Jola Ear-Head Fly.

The investigation of this pest begun seven years ago but interrupted by pressure of other work has now reached a stage when an announcement may be made regarding the line of control that is likely to be found effective. The minute red fly is a serious pest on jola in the Mysore District and the adjacent localities where the crop is sown early after the rains received in March and harvested by about the end of July. The fly lays its eggs on the ovary of the jola flower and the maggot that hatches out so injures it that no grain is formed. In this way much damage is caused, the loss according to the ryots reaching as high as 30% in normal years and 80 or 90% in years when as a consequence of late rains the crop flowers later than usual.

The remedy that appears from the preliminary tests conducted to be most promising is catching the flies themselves. These are found laying eggs early in the morning on the flowers and fly upwards when disturbed. A date or grass mat with one surface smeared over with any of the heavy oils if dragged over the crop is likely to trap the insects which being very small and slender cannot escape once caught on the oiled surface. A sticky solution of flour paste spread over a cloth may prove equally effective. Heavy mucilage from suitable plants similarly spread over may also be found effective. These last two have not yet been tested. One or other of these may be found to suffice. The experiments so far tried have not been on a field scale. It is proposed to try them next year when the crop in a whole village will be taken up for treatment and the damage to the crop, so prevented, determined.

[K.K.K.]

[K. Kunhi Kannan]

SELECTIONS.

I

The Dietetics of Coffee.

Coffee is not harmful as a drink. Such, according to 'The Commercial Report of Brazil', was the conclusion reached by Professor Samuel C. Prescott of the Massachusetts Institute of Technology, after researches over a period of three years, made at the cost of 40,000 dollars.

Not only is coffee unharmful, but on the contrary, it is a mental and physical stimulant to the activity of an individual, declared the Professor.

Speaking before the National Society of Coffee Roasters in the city, Professor Prescott said that coffee is a valuable agent for counteracting fatigue and improves the capacity for muscular work and the power of concentration necessary for mental work.

Professor Prescott is the chief of the Department of Biology and Public Health of Technical Institute at Boston, and is one of the foremost scientists of the world. To him was confined the direction of the special studies promoted by coffee men, with the view of definitely establishing the truth respecting this product. The numerous experiments he had to make and remake during the course of his investigations resulted in the formation of a perfect laboratory for the study of coffee.

In his speech before the National Society of Coffee Roasters, Professor Prescott said :—

'After weighing the evidence, a dispassionate evaluation of the data so comprehensively surveyed has led to no conclusion that coffee is an injurious beverage for the great mass of human experience. On the contrary, the results of scientific experimentation point to the fact that coffee is a beverage which, *prepared properly and rightly used*,* gives comfort and inspiration, augments mental and physical activities, and may be regarded as the servant rather than the destroyer of civilization.

'Coffee, properly prepared, has a remarkable stimulating and fatigue-relieving effect, due to the action of caffein, which acts on the central nervous system. It promotes heart action mildly, increases the power to do muscular work, and increases the power of concentration of mental effort, and is therefore an aid to sustained brainwork. It has no depressive after-effect. It is not habit-forming, and does not require

* Italics are ours.—Ed., J. *M. A. E. U.*

continually increasing quantities to give satisfactory stimulation. The action of caffein may be likened for purpose of visualization to lubrication of machines, although the analogy is not perfect.'—*Planters' Chronicle*, Vol. XX, No. 32.

II

Pedigreed Cattle.

Pedigree in cattle is as yet an unknown quantity in India. Even the oldest herds of well-known cattle can only trace ancestry back to 3 or 4 generations. In Europe the forefathers can be traced back for a century or more and the cattle-breeder with an eye for the right stock and the instinct for breeding obtains high prices for his animals. The value of a well-bred pedigree cow may be gathered from the history of Hobsland Jean, the fifth which died recently in her eleventh year. Her calves and the prices obtained for them were :—

1st Bull	£ 315
2nd Bull	£ 1,000
3rd Bull	£ 205
4th Bull	£ 1,780
5th Heifer	£ 525
6th Bull	£ 210
7th Bull	£ 210
8th Heifer 9th Bull	Still calves.

If we presume that the last two calves are worth £ 200 a piece, this cow returned to her owner £ 4,645 or nearly Rs. 70,000 for her stock alone. Beyond this her yield of milk and the percentage of butter fat were high, although they do not compare with those of some of the record breakers of recent years. Her yields are given below :—

Year	Yield	Butter fat
1916	11,250 lbs.	3.97%
1917	9,450 lbs.	3.75%
1918	10,000 lbs.	3.70%
1919	10,000 lbs.	3.98%
1920	11,360 lbs.	3.70%
1921	13,490 lbs.	3.61%
1922	11,900 lbs.	3.80%
1923	11,560 lbs.	3.87%
1924	11,440 lbs.	3.86%

Taking the total, 100,450 lbs. at 1d. a pound, an average wholesale price, the value of her milk was £419, or Rs. 6,285.

The cow is not, however, the dominating factor in breeding. The selection of his stud bull is the first consideration of the breeder. A cow produces only one calf a year whereas the bull fathers from 60 to 80. The crucial test is in the sale ring. The yearlings from a first class bull may average £200 a piece whereas those from a poor bull may average £20 a piece, £1,600 instead of 16,000 pounds.

The cattle-breeder is born, not made. No amount of education can develop "the eye for a bull". The breeder buys his bull as an immature yearling and on his perspicacity depends thousands of pounds.—*Bengal Agricultural Journal*, Vol. V, No. 2, June 1925.

III

* Studies on the Rice Plant and on Rice Cultivation.

We extract the following from Bulletin No. 114 of 1923 (Technical Series No. 1) of the Bombay Department of Agriculture :—

Summary of Conclusions.—The present stage of our physiological study of the rice plant, with a view ultimately to increase the yield per acre, enables us to draw a number of fairly definite conclusions which may now be summarized. Details of the experiments on which these conclusions are based will be found in previous chapters. Some of them are probably of general application, while others will apply only under the conditions of the North Konkan. These conclusions are as follows :—

(1) Seed should not be sown deeper than two inches. Surface sowing should also be avoided.

(2) The best seed-rate seems to be that which would produce neither thin lanky seedlings on account of shortage of space or tillered seedlings, due to extra space in the seed-bed. A seed-rate of seven to eight pounds per *gunda* of seed-bed (1/40 acre) brings about the desired results.

(3) Seedlings should be transplanted from about a fortnight prior to the formation of a node above ground to just a short time before it is actually formed. This stage is arrived at Karjat in a treated seed-bed in about twenty-four to forty days after sowing.

(4) The operation of transplanting does not seem to result in any physiological advantage to the plant capable of resulting in an increase in the yield. That tillering is encouraged by the stimulus of root pruning

* *Vide* Vol. VII, No. 1 of this Journal. We regret the summary referred to in the notes had to be held over from the last issue.—[ED.]

in the system of transplanting does not find confirmation in these experiments. Transplanting seems to be more an expedient than a requisite condition of cultivating rice.

(5) On transplanting, the old root system of the plant becomes unserviceable and the plant has to develop new roots for its use.

(6) Tillering is a factor of great economic value in rice cultivation and it is largely dependent on space and plant food. Other factors of cultivation such as the age and vigour of seedlings at transplanting, the number of plants per bunch, affect tillering to a limited extent. Too much tillering is again detrimental as it results in sterility of the late born tillers and uneven maturity of the whole crop. Heavy tillering is generally accompanied by a larger percentage of loss of later tillers and this occurs whatever the treatment is. The girth of the stem near the ground level is definitely and highly correlated to the length of the ear-head. The bigger the girth the longer is the ear-head.

(7) In a plant, the mother ear-head is generally the biggest under the system of planting. Certain circumstantial advantages, however, such as extra spacing, etc., tend to increase the size of the ear-heads of tillers over that of the mother culm.

Such are the results of our study of the effect of varying environments on the plant itself. The following summary indicates how this effect can be connected with the effort to increase the yield of the crop per acre :—

(*a*) To obtain the highest yield the seedlings should be transplanted upto but not later than the period of node formation above ground in the seed-bed.

(*b*) The vigour of seedlings does not seem to influence the yield in any way except in so far as it enables the plant to overcome adverse environmental conditions during and after transplanting. Again tillered seedlings seem in no way to improve the yield.

(*c*) A thorough puddling of the land is associated with high yield.

(*d*) According to the season and soil conditions in the North Konkan from four to six seedlings per bunch spaced nine inches both ways or six to eight seedlings planted twelve inches apart both ways seem to be the best practice.

IV

Intensive Nitrifying Bed as a Means of Preventing Nitrogen Losses from Cattle Manure.

SUMMARY.

Large losses of nitrogen occur when cattle urine is preserved under ærobic conditions. It was considered that it would be possible to prevent

such losses if the urine could be passed over intensive nitrifying beds where it could be subjected to the rapid action of nitrifying bacteria which would convert it into nitrates before any loss takes place. Experiments were, therefore, undertaken to find out whether such intensive nitrifying beds could be established and whether urine would be nitrified without loss of nitrogen, and it has been found that there are two ways of accomplishing this in practice. In one the urine is passed over a nitrifying bed and ultimately recovered as a solution of nitrates. In the other method the urine is absorbed by means of a specially prepared or activated soil.

A general outline of working these processes is included in the paper to enable those interested in the subject to make their own trials.

In the first method, pumice or broken bricks serve as suitable substrata for the organisms in the nitrifying bed. The depth of layer of liquid to be nitrified possesses great influence over the nitrification process. Urine could not be nitrified directly without dilution in the nitrifying beds up till now. With the most active bed prepared so far urine requires to be diluted with ten times the quantity of water.

In the second method, soil prepared by previously nitrifying some nitrogenous material in smaller quantities and washing out the nitrates is used for absorption of urine. If ordinary local soil is used for absorbing the urine directly without any such preparation large losses of nitrogen (approximately 70-80 per cent of the original amount) occur. The object of preparing the soil is to activate the nitrifying organisms and thus make the soil capable of nitrifying the high quantities of nitrogen in the urine rapidly and thus prevent losses of nitrogen which would otherwise occur.

It is estimated that about 2.5 mds. of potassium nitrate, *i.e.*, pure *shora*, may be obtained from a single animal's urine (containing about 1 per cent of nitrogen) if it were converted into potassium nitrate by this process of intensive nitrification, provided no loss of nitrogen took place during handling.

Even if the crudest method of handling alone is possible for any individual resulting only in 50 per cent recovery of the nitrogen in urine as nitrate, and the nitrogen content of the urine of animals be half of what was found in the case of the dairy herd at Pusa, it is estimated that 1—1½ mds. of potassium nitrate or a manure containing an equivalent amount of nitrogen therein will be easily obtained per year if the urine of a pair of animals is regularly subjected to this process. It will be seen, therefore, that the urine of animals conserved in this way will go a long way to meet the manurial requirements of the cultivators.—*The Agricultural Journal of India*, Vol. XX, Part I.

V

European Planters Entertain Dr. Coleman.

We take the following extracts from the Proceedings of a Quarterly General Meeting of the Mysore Planters' Association held at the Kadur Club, Chikmagalur, on Monday, June 29, 1925, published in the *Planters' Chronicle*, Vol. XX, No. 30 :—

Before proceeding with the business of the meeting, the Chairman (Mr. E. W. Fowke) rose and expressed his pleasure at Dr. Coleman being able to be present.

He said it was with great regret that he had heard that Dr. Coleman was going on leave and that he hoped he would come back with health renewed. He then asked Col. Crawford to address the meeting.

Col. Crawford spoke as follows :—'Mr. Chairman, Dr. Coleman and Gentlemen, We have all learnt with extreme regret and sorrow that Dr. Coleman is shortly leaving Mysore on two years' leave, and we trust that the change and rest will completely restore him to health and that he may yet see his way to return to Mysore and continue the wonderful work he has so quietly and modestly been doing for the Ryot of Mysore in particular, and for India generally. If you will bear with me, I will endeavour to give you a very small idea of what he has accomplished during the seventeen years he has been in the State, the magnitude of it, and the immense benefit it has conferred on the agriculture of the country. Under Dr. Coleman new and improved varieties of ragi, sugarcane, cotton, groundnut, silk-worm seed, etc., have been bred on the various experimental farms he has under him and distributed throughout the country.

To give but a few instances of the activities of his department and the way the work is appreciated by the ryots and what his personal influence has done, I may tell you that during this year 50,000 acres will be planted with new varieties of ragi on the various villagers' lands and at a low estimate the new varieties give as much as Rs. 10 per acre more crop than the old varieties or quite five lakhs of rupees more profit to the cultivator.

There are 6,000 acres under the new varieties of sugarcane and the average yield is not less than Rs. 100 per acre, additional profit to the grower or an increased profit of six lakhs of rupees on this crop alone

There will also be 25,000 acres planted with new sorts of groundnut introduced by Dr. Coleman and this is expected and doubtless will give an additional profit to the ryot of about ten lakhs of rupees more than would have been the case with the old kinds of seed. The additional profit to the silk growers, cotton planters, paddy growers, cattle and sheep

breeders who have sought the help and guidance of the Agricultural Department, must be very great, to instance one example, the ravages of *Kole Roga* on the areca trees, a disease discovered and studied by Dr. Coleman who was fortunately able to find a remedy for the pest, and now the areca growers on their own initiative carry out the instructions and advice of the Agricultural Department and spray over 10,000 acres of areca and thereby save not less than twenty lakhs of rupees of crop each year. Previous to Dr. Coleman's discovery there seemed no hope for their industry.

Dr. Coleman has not been able to do much for the coffee, cardamom and pepper planters as he has not been given the money or the staff with which to do what he would gladly have undertaken for our industries, but he has put us on the way to lessen the ravages of borer, and his spraying experiments on coffee are most encouraging: his advice on manures and manuring have been most valuable and his advice and assistance has always been at the diposal of any planter who wrote to him for advice.

In Dr. Coleman's departure we are all losing a man supreme at his job, also a man who loved his work and the people of this land, and who unstintingly gave of his best, in spite of ill-health and a crushing domestic bereavement which would have broken a less indomitable character.

In conclusion, gentlemen, I say, we and the people of Mysore are parting with a very true friend whom it will be impossible to replace. He has in a supreme degree Kipling's "common touch" and has endeared himself in a wonderful way with all with whom he has come into contact, from the highest to the lowest, and he is every inch a man and a scholar whose modesty and kindliness are only equalled by his sense of honour and duty.'

Dr. Coleman, replying, said he felt most deeply moved by the words of his old friend Col. Crawford and by the way in which these words had been received. It was seventeen years ago that he paid his first visit to the planting districts and this visit had been to Col. Crawford's bungalow. He expressed his regret that he had not accomplished all that he could have wished to have done for the planting community, both Indians and Europeans. Dr. Coleman then proceeded to explain the present position regarding the Coffee Cess and Experimental Station and asked for an expression of the Association's views on these questions. After these matters had been discussed at great length the following resolution, proposed by Major Hill and seconded by Mr. Godfrey, 'That in view of Dr. Coleman's statement regarding the Mysore Coffee Experimental Station, this Association resolves to move and press at the Annual General Meeting of the U.P.A.S.I., that the Upasi Coffee Cess of two annas per acre be continued

pending further information from Dr. Coleman and that the U.P.A.S.I. endeavour to urge the Madras Government to continue its offer of a contribution to the Coffee Station,' was put to the meeting and carried.

The following resolution, proposed from the Chair, 'That the Member of Council, representing the European Planters, take an early opportunity of interviewing the Dewan of Mysore and endeavouring to ascertain the attitude of Government towards the proposed Experimental Station for Coffee and other products in the Malnad,' was also passed.

Mr. H. Browne then proposed and Mr. Dennis seconded a resolution, 'That this Association is of the opinion that a Coffee Experimental Station is absolutely necessary to combat increasing disease and to maintain the quality of East Indian coffee, and that the best possible service that could be obtained anywhere is now available in the person of Dr. Leslie C. Coleman whose services must be retained, and this Association is prepared to pay any reasonable cess to secure his services provided that Government is prepared to pay an equal sum for this purpose.'

This resolution on being put to the meeting was lost.

The Chairman then proposed a hearty vote of thanks to Dr. Coleman. Major Hill, seconding, said that he hoped that Dr. Coleman's health was not impaired and that we should see him back again after his period of leave was over.

Mr. Newcome then proposed and Col. Crawford seconded, 'That this Association places on record its appreciation of the immense benefits already conferred on the agriculturists of Mysore by the Agricultural Department under the very able guidance of Dr. Leslie C. Coleman and deplores and looks with profound apprehension at the possibility of his leaving his life-work in Mysore unfinished. This Association further pledges its members to support to their utmost the proposed Coffee Cess for the Coffee Experimental Station under Dr. Coleman.' (Carried unanimously.)

VI

The Utilization of Seedlings in the Estimation of Soil Nutrients.

The farmer has learnt how the yield of his cultivated areas can be increased annually by unremitting toil, attention and capability, better methods of tillage, use of improved seed, the prevention of plant diseases, and above all by the liberal application of fertilizers. The farmer used to follow the approved advice of Paul Wagner (Darmastadt) and gave his fields only a limited amount of nitrogen, which was expensive and can not be retained by the soil, while he applied an excess of potassium and phosphoric acid, without considering whether the repeated manuring with

these fertilizers had not satisfied the potassic and phosphoric requirements of the soil to the extent of rendering it advisable to diminish the amount employed. This carelessness was due to the fact that the potassium and phosphoric acid were cheap and easily obtained. Those days are now past, and the universal economic depression has extended to agriculture, so that the farmer can no longer indulge in the luxury of wastefulness, but is obliged to exercise the strictest economy not only in the management of his capital above ground, but also in the use of the valuable stock of plant nutriment that lies hidden in the soil. To employ this treasure aright necessitates a thorough knowledge of its character and value, but unfortunately the agriculturis is still ignorant of its nature and importance in spite of all the efforts of science and of the practical investigations that have been carried out.

Hitherto, three methods have been employed for determining the nutritive substances present in the soil: pure chemical analysis, manurial field experiments and vegetative experiments with plants in pots. All these methods have proved inadequate for the purpose. Chemical analysis is in the first place far too rough a test, for the soil chemist can only analyse correctly up to hundredths per cent, his results being inaccurate for thousandths per cent. Since, however, the soil over 1 hectare of surface taken to the depth of the plough furrow weighs about 3 million kilograms, one thousandth per cent is 30 kg., and an error of five thousandths per cent, a mistake easily made, would give 150 kg., which is far too high a figure. Chemical analysis is also unreliable for another reason; the chemist can determine without difficulty the total amount of any nutritive substance contained in the soil, but he is unable to state how much of it can be taken up by the roots and assimilated by plants, which is the important point. No certain results have hitherto been obtained from the chemical soil analyses made for the purpose of ascertaining how much nutritive matter the weak efforts of plants have succeeded in wresting from the soil. If any chemist were to affirm to the contrary, he would probably not find a single practical agriculturist ready to believe him, for unwavering confidence in the case of such predictions is more difficult than under any other circumstances, because the store of nutritive substances present in soil is not the only growth factor. The crop-yield depends upon other conditions, especially upon the weather, therefore even if the estimate of the amount of nutritive substances in the soil were correct, there would not infrequently occur a discrepancy between it and the harvest, and it would need great faith on the part of the practical agriculturist to realize that the difference in the theoretical and the calculated values, was not to be attributed to the mistake of the soil-analyst.

Therefore let us dispense with all chemical methods. Plants alone are able to give a reliable answer to our questions. Field manurial experiments and pot-cultures are the only forms in which the problem has hitherto been applied to plants, and such methods will always be valuable for soil investigation and throw light upon the subject of plant nutrition, but unfortunately, they are troublesome and lengthy. Any one who has conducted manurial experiments in the field is well aware of the difficulties they present. Very often these experiments are interfered with by the weather, so that accurate results are only obtained if the researches are extended over several years. Pot-culture experiments are less dependent upon weather and have reached a high stage of perfection, but they require an extensive and special equipment which few Institutions possess and could now only be purchased with difficulty owing to the high cost of material. Further, pot experiments are very long and troublesome and hence expensive ; therefore, it is quite impossible for agriculturists to obtain by this means, and within reasonable time, any general information respecting the nutritive substances content of their cultivated soil. Hence there is urgent need of a method of mass experiment, by which any Experimental Station can carry out, without new, costly apparatus, hundreds and even thousands of soil sample analyses, to determine the nutritive substances present in them which can be assimilated by plants. Farmers should be given the opportunity of forwarding samples of their soil at all seasons, in summer as well as in winter and these samples must quickly, cheaply and accurately investigated, just as fertilizers and stock-feeds are tested. In this way, it will be possible, not only for the few favoured individuals who are in a position to conduct plant experiments but also for the great mass of agriculturists, to suit the fertilizers applied to the requirements of their various soils and thus to form systematically a result that is of paramount importance, both from the point of view of national economy and the nation's food supply.

The principle upon which is based the carefully worked-out method * devised by myself and my colleague Dr. Wilh Schneider (Bonn) is the hitherto unknown fact that young seedlings do not live as long as possible upon the reserve materials of the seed, but employ their rootlets as soon as they are developed, to obtain nutritive substances from the soil.

If a large number of young seedlings are planted in a small quantity of soil, the starving rootlets extract all the assimilable nutritive substances their strength permits, but leave untouched the non-assimilable matter.

* "Die Nahrstoffaufnahme der Keimpflanzen und ihre Anwendung auf die Bestimmung der Nahrstoffgehalts der Boden" *Zeitschrift fur Pflanzenernahrung und Dungung*, Part A, 2., Year 1923, No. 5. Leipzig.

In this manner, the plant rootlets separate out the soluble from the in soluble substances, thus rendering a valuable service also to the chemist, since their choice is certain and leaves no room for doubt.

Our experiments were conducted as follows :—Upon the level bottom of some small glass dishes, measuring about 100 sq. cm. at the base and 6 cm. high, were spread 100 grams of the soil to be tested, mixed with 50 grams of pure quartz-sand, the so-called "Glass-Sand" which is free from any nutritive substances. Over this was laid 250 grams of damp glass-sand and upon the smooth surface were planted 100 seeds of the best, heavy, seed-rye. The seedlings soon germinated; they were carefully tended, and removed with their rootlets after 17 to 18 days and analysed. Only part of the mineral substances entering into the composition of the seedlings thus came from the soil to be tested, for a considerable amount was derived from the reserve stores of the seed. For this reason, we also carried out a blank experiment on barrens and to which no soil had been added and subtracted the nutritive substances found from the total before obtained. The remainder was clearly derived from the soil.

So far, we have only used this method for the determination of potassium and of phosphoric acid, but we are convinced that it could also be employed in the case of other nutritive substances, such as nitrogen, for instance. The amount of potash yielded up in this manner to young rye-seedlings by 100 grams of soil, ranges, according to observations made, from 5 to 100 mg. while the phosphoric acid varies from 0 to 25 mg. Since 1 mg. for 100 grams of soil is equivalent on an average to 30 kg. per hectare, the young seedlings on one hectare of soil abstract from the soil up to 3,000 kg. of potash and up to 750 kg. of phosphoric acid in 18 days. These amounts appear very large at first sight but in reality they are very small. The seedlings used in the experiment were starving, which was necessary, otherwise they would not have exhausted the soil, but plants under natural conditions take up a much larger amount of nutritive substances in the same short space of time. The reason that they do not exhaust the soil to an equal extent is simply that our cropping plants naturally have a thousand times as much soil at their disposal. Parallel determinations made according to the new method agree as exactly as chemical analyses, provided they have been executed by skilful and trained persons.

As can be seen from this brief description, the new method not only has the advantage of being quickly carried out by means of small packets of samples that can easily be forwarded by post, but it also has another

point in its favour. Whereas in other vegetation experiments it is necessary to insure the optimum condition of the growth factors that are not involved in the test, and to supply an excess of all the nutritive substances not under consideration, in this new method all that is required is water and warmth. Especially good illumination is not even essential. In this manner, the carrying out of the experiment is greatly simplified, there is no danger of producing unwelcome changes in the soil by the addition of other matters and it is thus possible to use the same material for the determination of the root solubility of many nutritive substances instead of being necessary, as hitherto, to fit up the experiment anew for each fresh compound. In the usual type of vegetation experiment, the amount of nutritive substances contained by the soil is estimated from the yield of plant substance when the plants are gathered. Therefore, the nutritive substances in question must not only have been taken by the plants, but also turned to excellent account, which according to the "Law of minimum", or as it is now called the "Law of the influence of growth factors", is only possible when all the growth factors not involved in the test are at their optimum. By this method, however, there is no need to ascertain what the plants do with the nutritive substances they have absorbed from the soil, it is sufficient to ascertain the amount they have abstracted. Fortunately, the law of the influence of growth factors, which is so troublesome in other experiments, does not appear to affect the mere abstraction of nutritive soil substances by very young seedlings that still possess a large store of reserve material. We may imagine the plants saying, "Let us diligently collect only stones for building and we shall soon find means of using them". In the open fields also, the first efforts of the germinating seed in early spring, are directed to collecting building material to be used later, when the chlorophyll apparatus has become strong, under the influence of more intensive irradiation.

From what has already been said, it is clear that a much larger number of tests can be made by the new method of vegetation experiments than was possible to carry out with the old systems; further, the experiments can be conducted at all seasons of the year. One important question, however, remains to be answered, *viz.*, is the new method accurate and trustworthy? That it is based upon existing laws has been shown by the agreement of parallel experiments and the great differences in the data obtained in the case of soils of unlike composition. How far this method is practically feasible must be decided by comparing the results obtained with those found by means of field manurial experiments, but as these are themselves affected by several sources of error, it is advisable to take the soil samples from experiment fields that have been long under

observation. This has, in fact, been done, and I have always requested my colleagues when forwarding such samples, not to give me any information respecting the nature of the soil and its condition as regards fertilizers, until I have reported the findings of my experiments and made my calculations. They invariably complied with my wishes, with the result that will presently be given.

In order to determine by the seedling method the nutritive substances required by a soil, it is needful to know how many mg. of each nutritive substance must be contained by an amount of the said soil, corresponding to 100 grams of the dry substance.

Judging from our present experience, we are of opinion that the highest yields can only be obtained from the plants in question (in the absence of potassic or phosphatic fertilizers), when it is possible for the seedlings to abstract, from a quantity of soil corresponding to 100 gms. dry substance, the following minimum amounts:—

	Potassium	Phosphoric acid
	mg.	mg.
Rye Wheat	14	8
Barley, Oats	18	7
Red Clover	29	9
Lucerne	34	13
Meadow Plants	38	10
Potatoes	37	10
Sugar-beets	39	12
Mangels	60	14

It is necessary to remark that these limits are based upon a general estimate and must be supported by the evidence of further experiment.

They apply to arable soil of the medium depth of 25 cm., where no nutritive substances have been added to the sub-soil. It is of paramount importance that the amounts of nutritive substances supplied are enough to produce a maximum yield. Should it be impossible to obtain a maximum crop owing to the mechanical composition of the soil tested, or to the climate or lack of water, smaller quantities of nutritive substances that can be assimilated by plant roots will be sufficient. Therefore, the data obtained from the seedling-method cannot be used as a general scheme. This objection applies not only to our method, but also to all other artificial systems. Field manurial experiments are indeed free from this limitation, but they have many other drawbacks.

The testing of our new method by the investigation of soil samples from experiment fields of known condition as regards fertilizers, included

65 potassium and phosphoric acid determinations. Most of the data are given in the above-mentioned treatise and as space is lacking here to reproduce the tables, it is only necessary to state that the agreement between the figures found and the condition of the fertilized fields, was in every case very satisfactory.

The following facts have not hitherto been published. The figures represent the amounts (in mg.) of potassium and phosphoric acid found by means of the seedling method in a quantity of soil corresponding to 100 gm. of dry substance. The experiments were conducted in the experiment field of the University of Halle (Saale). This field had been planted with rye uninterruptedly since 1879 ; it was manured annually with stable-manure and also with chemical fetilizers.

Kind of Fertilizer.	Potassium	Phosphoric acid.
Unmanured	9.9	5.1
Nitrogen alone	7.2	3.5
8,000 kg. stable-manure	18.0	6.8
12,000 kg. „	22.2	8.3
Complete mineral fertilizer without nitrogen ..	35.0	15.0
Complete mineral fertilizer	30.6	16.7

The figures agree very closely with the actual conditions.

Experimental Field of Gottingen University.

The field had been planted with regular rotations of crops for 30 years and manured during that time as follows. No lack of potassium was noticeable (except, in the case of very exacting plants), even on the plots that had received no fertilizer.

Kind of Fertilizer used	Potassium	Phosphoric acid
Unmanured	29.1	19.7
Nitrogen only	21.7	14.8
Phosphoric acid only	26.2	25.1
Potassium only	56.0	19.5
Complete fertilizer without potassium	25.5	17.4
Complete fertilizer without phosphoric acid ..	57.5	19.3
Complete fertilizer without nitrogen	61.9	22.0
Complete fertilizer	59.4	21.4

Here again the experiment results were a true reflection of the soil conditions as regards manuring.

Experiment Station of the Agricultural College "Landwirtschaftliche Hochschule") of Bonn-Poppelsdorf, Bonn.

The experiments have been in progress since 1896. No lack of phosphoric acid has been shown even on the unfertilized plots. On the plots without potassium, the yield was little decreased in the case wheat, but was much lower than usual in some instances where the

crops were of a more exacting character. The fertilizers were not heavily spread as in the case of the Gottingen experiments but the amounts given were calculated to replace, as far as possible, the substances abstracted by the crops.

Kind of Fertilizer	Potassium	Phosphoric acid
Complete fertilizer without nitrogen	24.5	15.8
Complete fertilizer without potassium	14.8	14.9
Complete fertilizer without phosphoric acid ..	25.6	9.0
Complete fertilizer	22.3	11.3

The figures found gave a very accurate conception of the condition of the field as regards fertilizers.

Soil composed of weathered Bunter-sandstone : field manurial experiment with winter-barley ; previous crop five-year lucerne. The figures obtained were : potassium 54.6 mg., phosphoric acid only 4.0 mg., therefore the soil must be regarded as very rich in potassium, but poor in phosphoric acid. The field manurial experiments gave the following results :—

Unmanured	2950 kg.	grain.
Manured with nitrogen and potassium ..	3090	,,
Manured with nitrogen, potassium and phosphoric acid	4720	,,

Here again, the manurial condition as shown by the behaviour of the young seedling method was fully confirmed by the field manurial experiments.

The new method will be further extended with a view to the determination of the lowest values that will provide the amount of nutritive substances necessary to completely satisfy the requirements of different plants under various conditions of soil and climate, even in the case of a maximum yield. Whether rye is the best plant to use in these researches, will also be investigated, and whether it is sufficient to keep to a single variety of plant throughout the experiment.

The success already attained inspires us with the hope that this new method will be adopted in all Agricultural Experimental Stations, as being a valuable aid to research, and useful in giving every farmer the opportunity of obtaining a clear idea of the store of nutritive substances present in his soils. It is hoped also that the scope of the new method will be further extended, for we believe it will prove of great service and enable us to penetrate quicker and deeper than heretofore into many of the domains of soil science and of plant physiology.—*International Institute of Agriculture*, Vol. II, No. 4.

VII

Agricultural Research in Relation to the Community.*

Sir Daniel Hall, K.C.B., LL.D., F.R.S.,

Chief Scientific Adviser to the Ministry of Agriculture and Fisheries.

It is a common reproach that agriculturists have not made the same use of science as have those engaged in the other great industries that farming is still a rule-of-thumb process carried out by methods which have their origin in the dark backward and abyss of time. In some respects this is indeed true. One has only to read Cato or Columella to realize that the Italian peasant of to-day is working and living in very much the same way as his Roman forbears, and even the more highly organized farming of Great Britain or Denmark or Holland is carrying on many of the essential operations of cultivation on lines that were laid down by the first great civilizers—the Romans. It is easy in fact to trace modern agriculture to a Roman ancestry; in Britain, for example, by the transplantation from the fifteenth century onwards of the traditions and practices that persisted through the Dark Ages in the Low Countries.

None the less progress has taken place and scientific development is going on. Under mediæval systems of agriculture the yield from England's land was of the order of six to eight bushels of wheat to the acre. The enclosure of common lands, the introduction of a recuperative clover crop into the rotation and of forage crops like turnips for the winter feeding of cattle and the making of farmyard manure, the return to Roman methods, in fact, raised the level of production to about 20 bushels of wheat per acre. This was about the average when agricultural science dawned nearly a hundred years ago—say about 1840, when Liebig exposed his theory of plant nutrition and Lawes began his experiments at Rothamsted. Growing scientific knowledge and the introduction of fertilizers raised the level of English production by 50% during the next generation, so that by 1870 the average yield of wheat per acre in England had become 32 bushels. At that level it has more or less remained down to the present day because a new factor then came into play, the importation of cheap wheat through the opening up of the Middle West of the United States, and of Argentina and Australia. The economic factors of gold scarcity and rising costs of labour co-operated to limit the profit attached to high farming; the English farmer had to cheapen his production and lower his standard so that he only obtains the same yield to-day, though the acreage under wheat has shrunk on to the better land

* An Address delivered before the Graduate School of the U. S. Department of Agriculture, 26th January 1925. Reproduced from *Science*, 17th April, 1925.

Latterly we have seen the yield creeping up a little through the introduction of heavier cropping wheats—the products of scientific research.

In other directions there has been progress. The introduction of the self-binder alone has meant great economics in man power. I estimate that by the use of machinery in one way or another English farming, with an equal or greater output, employs some 25% less labour than it did fifty years ago. Cattle feeding is more economic. Breeding for early maturity, better adjustment of rations either for meat or milk production, have all tended to a cheaper output. There is still an immense margin for improvement. From scientific experiments one may calculate with some degree of confidence how much meat and milk a given quantity of fodder of one kind or another ought to yield. Yet when in the Dark Days of the war we took stock of our resources of cattle food, because tonnage could no longer be spared for aught but human food, soldiers or munitions, it was estimated that in the five years before the war the farmers of the United Kingdom at large only realized one-third of the meat and milk that was theoretically possible from the fodder that had been then available.

Disease amongst animals is another field in which research has not been idle; enormous savings have been effected in the average efficiency of our flocks and herds. Yet last year Great Britain had to pay a bill of approximately 20,000,000 dollars to stamp out foot-and-mouth disease, and this was compensation only for slaughtered animals and took no account of the losses to farmers endured by the break-up of their businesses.

Great are the achievements and still greater the possibilities of agricultural research, but we must recognize that there are limitations to the effect of science upon agriculture which do not hold for the other industries. In the first place, in agriculture we are dealing with a living organism and the amount of control that we have obtained over plant or animal, over that stubborn essence we call life, is far less than we can exercise over inanimate nature, over iron or cement, over even the ether or the atom. When we attack vital problems we find that we cannot speed up processes or enlarge the unit in the way we can deal with the dynamo or spinning frame. It still takes the wheat plant six or nine months to develop and cows bring forth their calves neither more quickly nor more numerously for us than they did for Abraham. We see no way of growing three or four crops a year under temperate climatic conditions. The organisms we are dealing with will go through their cycle and you cannot hurry them. When you start hustling you find you let in secondary troubles of all sorts.

These limitations lie in the nature of things, and though on looking back we can count up the immense advances that agriculture owes to the application of knowledge we must not hope for sudden developments or revolutionary changes such as have been seen in flying or wireless telegraphy. In fact, for the time being, I am bound to say that agriculture is actually suffering from the rapid developments and scientific achievements that have distinguished other industries. I say this advisedly and most solemnly. Agriculture is the fundamental industry, because we must all be fed, and yet you cannot point to any part of the world where agricultural wealth is being turned out and find the producers in a flourishing condition.

The rewards in agriculture, whether to the capitalist *entrepreneur* or to the labouring man, are not commensurate with those obtainable in industry or commerce, and so men are being drawn away to the towns and capital is being diverted from the farms. The movement is one common to all civilized countries, its sources are social as well as economic. The lure of the town has been secular, but modern facilities of communication and transport have given it a range of action hitherto unknown; yet it cannot go on for ever, for the world must be fed. One must interpret the steady rise of food prices which has marked this century, a rise now being resumed after the excessive fluctuations caused by the war, as evidence that we are approaching a limitation to the development of the towns because there is not food enough to go round.

The old economist would see a simple solution to this impass; prices of food have only to rise sufficiently and men will be attracted back to the land in order to secure the profits it promises—the balance will be restored. But, looking back historically, has this ever happened? I can find no example of an urban population migrating into the country. If the countryside does replenish itself in men it is by breeding and by finding space in the country for the country bred. The great increase in the food supplies of the world the last half century has witnessed has been due to the new countries becoming accessible, whereby opportunities were given to the rural population to put their sons on new land. But that process is merely at an end, there are no longer the great vacant areas waiting for men.

Are we not to look for progress in another direction; can we not so intensify the farming of our existing land by taking advantage of science, machinery and organization that agricultural production will become an industry capable of competing against other industries for men and capital? It was by a process of this sort, by enclosing the common lands and building up small capitalist business, that Britain succeeded a century

and a half ago in meeting the needs of a population which was then beginning to expand as the industrial age approached. Our businesses have remained small, too small to be efficient to-day perhaps and I can point to few examples of large-scale industrial farming in successful operation.

In fact, though I pin my faith to big business on the land as necessary to the future production of food in order to meet the growth of cities, I am bound to say that the current seems sweeping in the other direction. Agricultural businesses, such as we have, find it difficult to pay the wages that will retain men on the land, with all its disadvantages of quietness and lack of amusement. Social and economic motives in our country are working towards the break-up of farming businesses into single-man or rather family farms, and similar forces have been even more powerfully at work in Continental countries in dividing up the land. The desire of men for independence, the determination to call no man master, the innate feeling among country folk that a man has a right to a bit of land of his own to vote or to a soul of his own, makes in many countries the single-man holding a burning political question. And the man is ready to pay,—to pay in labour, in days that endure from dawn to dark, in days that include the hours of his wife and children, in toil as against the regular pace of a factory, for the privilege of being a landowner.

But I doubt whether the process is fundamentally economic. Farming may become immediately more intensive when a great estate is cut up into small holdings, but the community so created becomes an unprogressive one, little fitted to take advantage of modern science, modern machinery, modern organization. It is fundamentally uneconomic because it is employing more men than are necessary to produce the food on which the community can be supported. I conceive it to be possible for 15 per cent. of the working population to be able to produce the necessary food for the rest of the nation, and the larger the margin that remains after this prime task has been performed of men who can be making boots and clothes, houses and motor cars, the greater the divisible wealth of the community.

But the only hope I can see at present for large-scale production, for organized industry on the land, lies in the advances that science can make. It is research alone that will enable the big agricultural business to compete with the excessive labour of the one-man farm, to pay wages and give conditions of life to its workmen equal to those prevailing in the urban industries. It becomes then a matter of the first import to the growth of civilization itself, not merely to agriculture, that agricultural research should be encouraged.

We may consider research from two points of view. In the first place, it is an intellectual affair carried out by the individual in response to the insatiable curiosity of the mind about its surroundings and its own existence. As such, it proceeds from an artistic impulse, it is not under control and it is not amenable to considerations of utility. Just as some men must write poems or paint or make music, as other men find themselves compelled to speculate to become philosophers or metaphysicians, so similarly the class of men, we are considering, must investigate nature.

The passion to do this is part of the man's make-up and cannot be created by any act of will on his part. I may remind you of the story of the old school-fellow who met Dr. Johnson at the height of his fame. "Doctor," he said, "I have often tried to become a philosopher myself, but cheerfulness will keep breaking in." And as a man cannot deny himself a desire to investigate, so he is not drawn to investigation by any ulterior motive.

I may take an illustration in the science of astronomy. Historically the study of the stars would appear to have had its beginnings in the search for useful knowledge. In the early civilization of Egypt it was necessary to find out a means of determining exactly the length of the year and the recurrence of the seasons. Later on the delusive promises of astrology led to further observation, and as we know, the first organized observatories were built for the service of the sailor for the drawing up of what we call a nautical almanac. But these prime necessities were easily satisfied and the real science of astronomy cannot, for the last hundred years, have served any useful purpose to any man. None the less, the development of the science and the foundation of observatories has proceeded at a greater pace than ever before, purely in response to the universal feeling of curiosity. Oddly enough, this kind of knowledge has proved itself singularly attractive to the American millionaire, who has latterly been the great founder of observations. Indeed the uselessness of astronomy is to many people one of its great attractions. A great astronomer once said to me, "One advantage I enjoy is that my science cannot make money for anybody. At least no merchant traffics in my heart." We may parallel this feeling with the remark of some noble lord who was being congratulated on his elevation to the Garter, "The best of the Garter is that it implies no damned nonsense about merit."

Research again possesses this quality in common with what are usually called the arts—its characteristic mental process is intuition. When we were students we used to be told that the two processes of thought by which science proceeded were deduction and induction. It was pointed out that the barrenness of the mediæval schoolmen was due to the fact

that they worked by deduction alone from imperfect premises. Bacon became the father of modern science by recalling it to induction and to the painful collection of facts. Bacon's apothegm was recalled, "Hypotheses *non fingo*," and it was suggested that the method of science was to collect an assemblage of facts and put them into some kind of sorting machine whereupon a theory will emerge. However, a little examination of the actual history of discovery soon shows that it does not proceed in such a fashion. The function of facts is to provide tests for your hypotheses, but you cannot begin to collect the facts unless you have preliminary hypothesis.

Let me take an example in the science of meteorology. For generations people made observations of the weather, set down the records of temperature, rainfall, barometric height and so forth. Nothing whatever came of these facts until in the study one or two workers evolved from their own consciousness the theory of the cyclone. Induction in fact failed. Bacon's other great catchword, "*Experimentum crucis*," showed that he really had a better appreciation of the true processes of science, and the really beneficial influence he exerted upon the early science of the seventeenth century was that he directed men's attention to experiment and to the mechanic arts as the sources of knowledge. To come back to our text, neither induction nor deduction complete the story of the mental processes by which investigation proceeds. We now realize a third category in the shape of intuition, the power of seizing the truth by a sudden flash of illumination. Indeed, the great discoverer may be a man in whom what is commonly called the scientific habit of mind is imperfectly developed. He may not be severely logical, methodical in his arrangement of facts, meticulous in accepting deductions.

As a recent example we may instance the late Sir William Crookes, whose marvellous discoveries certainly did not proceed by a process of minute but steady accretions from known foundations. By a sudden jump of mind he invented the radiometer, regarding which his explanations were mistaken, but his intuition led him from this point on to the whole gamut of high vacuum discovery which has resulted in such developments as the Röntgen rays, the elucidation of the structure of the atom, wireless telephony, etc. Sir William Ramsay provides another instance. In the eighteenth century Cavendish had noted that after removing all the oxygen and nitrogen from air a small residuum was left uncombined. In true scientific spirit he puts this down to the inevitable errors of the experiment. But working on the same track and worrying over the discrepancy between the atomic weights of nitrogen from different

sources, Ramsay's intuition led him on to the discovery of argon and the range of new light elements.

So far I have only been considering research from its intellectual side as a response to man's curiosity, but the nineteenth century proved it has also a practical side inasmuch as it led to an enormously increased control over the forces of nature. I need not sing the praises of what has been effected by steam, by electricity, by modern medicine; willy nilly the results are being incorporated into our daily life. Research leads to efficiency, and efficiency is a means of money. The modern State must cultivate research if it is to become efficient and survive in the world's competition; hence all are agreed now on the endowment of research, and since in farming there are no great business corporations, agricultural research must for many years to come be maintained by the State.

If, then, research is to become of such importance to the State, it behoves us to ensure conditions for the research worker under which discoveries are likely to be produced. To do this properly we must understand the psychology of the investigator. If it is true that research, like art, grows by a process of intuition we can no more organize it into existence than we can organize the output of poetry. Nor are we likely to obtain it by a system of prizes or rewards, commensurate to those obtained in the great professions, in industry or commerce. What we can do is to contrive sheltered places in our community in which research workers can live. We cannot guarantee results, but we may wait in faith because, as we have said, the impulse to make discoveries is fundamental in man's mind. Now the sheltered places in which the research worker can live are the Universities.

One last word, the State must have research in order to obtain efficiency, but does mankind really care about efficiency? At bottom man does not, he wants to "loaf and possess his soul". Efficiency is a beautiful word, but efficiency to what end? If pursued for its own sake it may become a curse. Many people have vivid recollections of the sufferings they endured under a really efficient parent in an efficient household. I, myself, am officially engaged in promoting efficiency, in bringing up the efficient farmer and in insuring the efficient use of the land. But I cannot help having a great deal of sympathy with the old-fashioned farmer, who is content with what the land brings him, who is making his living but not worrying over much about making money. He is often inefficient, but again he is often a very worthy human being.

To take another illustration, I have a vivid recollection years ago of a little piece of swampy meadow, half encircled by a brook, which after other wanderings found its way into the Thames. There was a

patch of reeds and willows, an old salley garden, where the reed warbler swung her nest and flitted through the tangled herbage. The wet meadow itself was starred over in August with Grass of Parnassus. It was indeed one of the most southern holds of that flower of the cool northern hillsides. Well, the efficient man came along, saw his opportunity, grubbed up the willows and laid out the meadow in watercress beds. He is a benefactor of his kind and has caused millions of blades of an edible kind to grow where there was none before ; but I have a sore spot in my heart for the vanished warblers and the lost Grass of Parnassus. I fear, however, that the pursuit of efficiency is one of those contradictory elements in man's make-up that won't let him rest, that is always urging him against his will towards further attainment. What a dreary prospect if it only results in adding an ever greater and greater population to a world always working harder and harder! Is there any way out of this *impasse*? I can only again suggest the kindly force of that other element in the texture of men's minds, the passion for artistic expression. The winds of beauty come and go, but as they rustle through the tree of life, among the dropping leaves that are ourselves, men will cease from their toil to listen and pause to retell in song or story, in paint or stone, the message they bring.—*The Journal of the Ministry of Agriculture*, Vol. XXXII, No. 4, July 1925.